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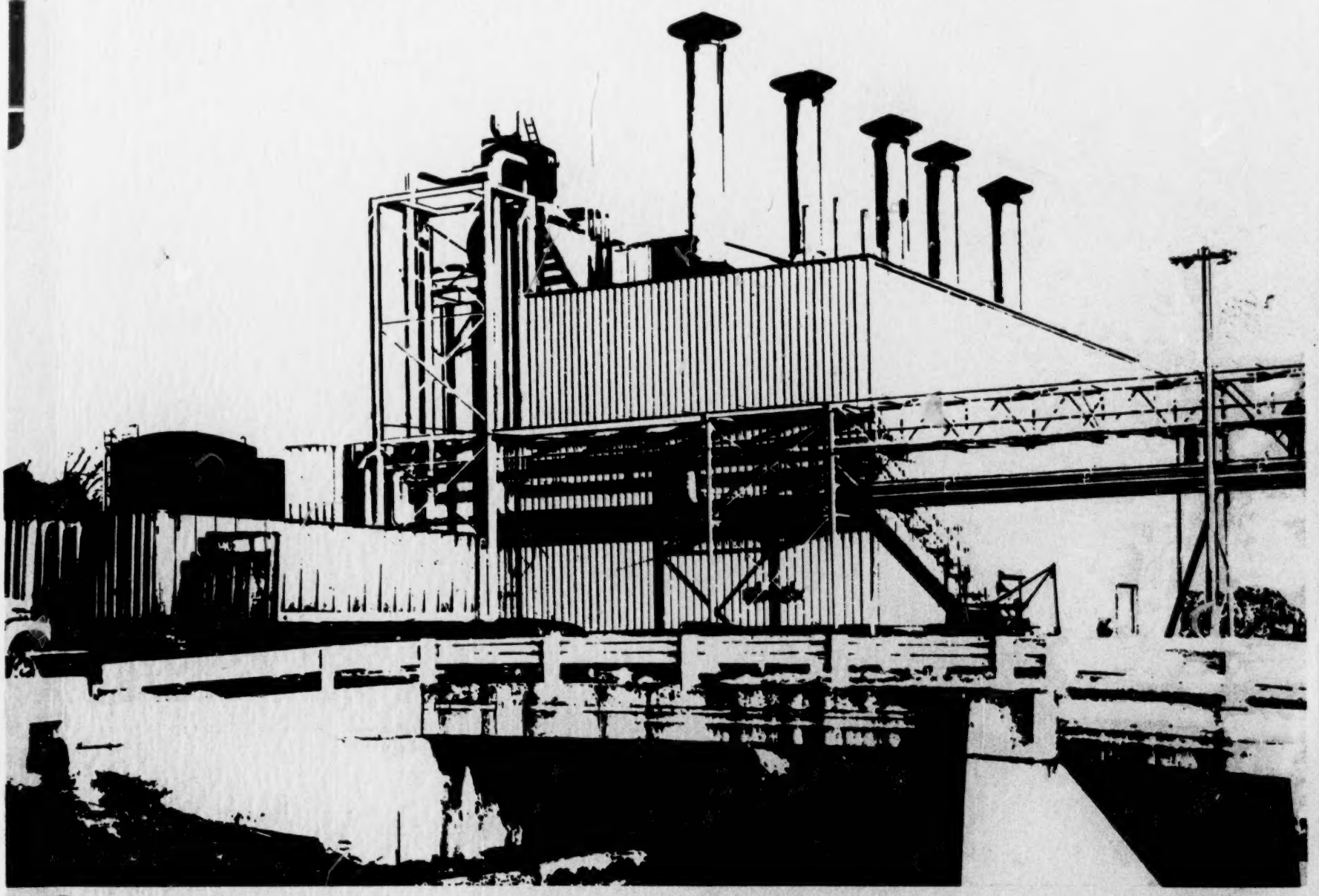
ABSTRACT

Prepared as a result of the author's concern for the role of industrial arts, and in conjunction with the Oswego Industrial Arts Technology Staff Development Program, this resource guide should help the industrial arts teacher integrate environmental education concepts into existing curriculum. It seeks to increase the teacher's awareness of some of the industrial and technological aspects of environmental problems, practices, and policies. The role of the industrial arts teacher is seen as an educational manager, directing and cultivating the perceptions of students toward environmental topics. Major sections of the guide are: (1) Introduction, (2) Perspective on Pollution, (3) The Role of Industry, (4) The Role of Government, (5) Direction: Industrial Arts and Environmental Education, and (6) Resources. Included as appendixes are: (1) an Environmental Glossary, (2) The National Association of Manufacturers Environmental Quality Committee, (3) Additional Companies With Environmental Answers, and (4) A Selected Reading List. (Author/JS)

# ENVIRONMENTAL EDUCATION RESOURCE GUIDE

## for industrial arts teachers



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DEPARTMENT OF
INDUSTRIAL ARTS AND TECHNOLOGY

# INDUSTRIAL ARTS AND ENVIRONMENTAL EDUCATION

## A RESOURCE GUIDE

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August, 1971

Prepared under a Staff Development Project at Oswego as part of an Education Professional Development Act Grant. Project Director: Dr. Thomas R. Jensen.

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ACKNOWLEDGEMENTS

Much of the material used in preparing this Environmental Education Resource Guide was contributed by environmentally associated personnel from industry, federal and state government agencies and educational organizations. I wish to extend appreciation to all those who shared materials many of which are noted in the resources section of the guide.

Special recognition is given to Mrs. Grace Manwaring, Associate Librarian at Oswego's Penfield Library, who assisted in the huge task of identifying environmental literature applicable to industrial arts. Her efforts not only provided data needed for the guide but also culminated in the development of the selected Environmental Education Reading List included in the Appendices of this guide.

For her typing services and the ability to convert first copy drafts into polished manuscript I am indebted to Mrs. Loretta Brancato, Staff Development Secretary. I also thank Mrs. Rose Kuzawski, Department of Industrial Arts & Technology Secretary, for preparing the stencils which make the reproduction and dissemination of this guide possible.

## FORWARD

Environmental education has emerged as a national priority in our public schools. Every curriculum area irregardless of content structure is challenged to weave environmental concepts and activities into existing or modified programs as the campaign continues to produce a next generation with some degree of environmental awareness and sensitivity.

This guide is the result of the writer's concern for the functioning role that industrial arts should assume in environmental education within the existing laboratory setting in the public schools. The Environmental Education Resources Guide was developed in conjunction with the requirements for Oswego's Department of Industrial Arts Technology's Staff Development Program which was funded under the Education Professions Development Act. It was the writer's purpose to conduct library and field research in the areas of industrial pollution problems and pollution control programs as they relate to the effects of technology on the environment and to determine the implications for industrial arts in environmental education.

Among the objectives of this study were:

1. Develop a comprehensive position statement for the inclusion of environmental education in industrial arts and publish this statement nationally.

2. Develop an "Industrial Arts Environmental Education Resource Guide" and investigate dissemination to secondary school industrial arts personnel.

3. Prepare a cassette tape in conjunction with the Industrial Arts Environmental Education Resource Guide that will be used to orientate and direct the reader through the examination of the guide.

4. Compile bibliographies of suggested readings, audio-visual materials, and agencies in environmental education that could be used by industrial arts practitioners.

5. Prepare an audio-slide series on the topic, "Environmental Education: Industrial Arts and Pollution."

6. Recommend implications for environmental education in industrial arts at the teacher training level.

7. Investigate the procedure used to apply for federal monies under the Environmental Education Act for conducting workshops, teacher institutes or similar programs dealing with environmental education at the teacher training level.

Within the structure and content of this Resource Guide all but objectives 3 and 5 have been attained at the time of this writing. The scope of securing appropriate slides and preparing supporting visual materials will project the completion of the "industrial arts ecology visual units" into the 1971-72 academic year. Implications for environmental education at the teacher training level take the form of continuing programs such as those identified in objective 7 with or without funding under the Environmental Education Act or other sources. The college lab setting provides even more opportunities than the public school for the blending of environmentally-oriented activities into course structures. This Guide is designed to produce an environmental awareness and sensitivity for every reader.

The writer is continuing to pursue specific programs for implementation at the teacher training level, including the possibility of environmental education workshops, seminars and an elective course dealing with environmental education in industrial arts.

Preface To Resource Guide

The purpose of this guide is not to provide the industrial arts teacher with patent environmental education activities for specific laboratory settings. Such activities can only grow out of the merging of the teacher's environmental awareness and sensitivity with the students interest and enthusiasm in becoming "involved" in an educational climate which provides both the hardware and the exploratory, open-ended opportunities for interacting with the industrial and technological dimensions of pollution and pollution control. The purpose of this guide is to energize the industrial arts teacher-reader towards such an environmental awareness and sensitivity while at the same time discussing some of these same industrial and technological aspects of the environmental problems, practices and policies. Your students should be exposed to and involved with these aspects previously discussed through environmental concepts particularly germane to your laboratory setting. Your role will be one of an educational manager, directing and cultivating the perceptions of your students as they survey their environmental topics. You are not expected to, nor should you expect to, be an "educational answer-man". Such a limited perception of the learning process will not foster much success in any educational program. George Leonard, in his book Education and Ecstasy, aptly describes the limitless boundaries of learning (9, p. 51):

> All environment has the capacity to educate. We are rapidly becoming capable of controlling all environment we can perceive. It may someday turn out that what we can be will be limited only by what we can perceive.

Your own perception of what your students can accomplish and how they can individually develop will most assuredly establish your limits for your students in your courses. All the environmental facts and concepts in the world will be useless if they are not appropriately approached by a teacher with vision and insight as to how they affect developing students. There are no short cuts, no pre-planned project sheets, no easy answers to studying the complex problems of the environment. This call for a new role for industrial arts, that of establishing environmentally-oriented curricula activities is approached with a thought from Jerome Bruner (2, p. 315):

> Teachers have asked me about "the new curricula" as though they were some special magic potion. They are nothing of the sort. The new curricula, ... are based on the fact that knowledge has an internal connectedness, a meaningfulness, and that for facts to be appreciated and understood and remembered, they must be fitted into that internal meaningful context

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# INTRODUCTION

## Environmental Education: A New Priority for Industrial Arts

Environment! Pollution! Ecology! This trio of topics represents the most talked about, most written about and most read about issue of our day. From comic books to industrial in-house literature, from the daily newspaper to radio and TV commentators, from the gamut of commercial magazines to the educational journals, few social issues can claim such widespread coverage. As we move into the decade one can easily see that this "environment thing" is real and must be dealt with. Slowly, we have come to the conclusion that as individuals and as an industrial technocracy we made serious claims on air, water and land resources. These have resulted from combination of poor decision-making and our numerous examples of straight-line technology with little or no concern for unwanted by-products. Industrial pollution has been called the underside of affluence. We are now attempting to move from a society that didn't understand and in many cases didn't care, to an educated populace that has what President Nixon has phrased environmental literacy. What we are talking about is an awareness and understanding of the effects of technology on the environment, with a resultant ability to make future decisions that will prevent further damage to the ecology cycle.

Environmental Education (EE) has been identified as a high priority item by the United States Office of Education (HEW) consistent with the National commitment of the Federal Government.

U. S. Commissioner of Education, S. P. Marland, Jr. refers to EE as a catalyst for triggering funding commitments similar to the Environmental Education Act and for synthesizing the resources of the Federal Government (12, p. 8) Marland's article, "Environmental Education Cannot Wait," in the May, 1971 issue of American Education provides the reader with a glimpse of what EE is and how it should be implemted throughout the Nation's schools. To be effective EE must be viewed as a total effort to inject environmental concepts into the total school/community interface. We are talking about a multi-leveled, multi-disciplined approach which bring environmental concepts, activities and learnings into all facets of learning, from kindergarten thru adult education, in the English and industrial arts settings as well as the science labs. As we extend our narrow vision of the educational "disciplines" we are talking in the broadest sense about the societal disciplines of business, industry, civic groups, government agencies, each becoming a viable partner with the school disciplines in the environmental education venture. We are talking about partnerships that create real and meaningful education for today's eager youth.

The Environmental Education Act

The Environmental Education Act, less frequently referred to as Public Law 91-516, was signed on October 30, 1970. A selected

paragraph from the act describes the national need for environmental education (5, p. 1):

> Sec. 2. (a) The Congress of the United States finds that the deterioration of the quality of the Nation's environment and of its ecological balance poses a serious threat to the strength and vitality of the people of the Nation and is in part due to poor understanding of the Nation's environment and of the need for ecological balance; that presently there does not exist adequate resources for educating and informing citizens in these areas; and that concerted efforts in educating citizens about environmental quality and ecological balance are therefore necessary.

More specifically the act defines environmental education as "the educational process dealing with man's relationship with his natural and man-made surroundings, and including the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and urban and rural planning to the total human environment (5, p. 1)." Although it will be discussed later, it is appropriate to state here that the above definition reveals that industrial arts has a significant contribution within its interpretation of industry format. For the 1971 fiscal year Congress appropriated slightly less than two million dollars in funds available under the Environmental Education Act. Briefly stated, these monies were earmarked for activities which would permit (5, p. 3):

1. the exploration of new approaches to environmental education
2. the identification of specific needs
3. the sharing of ideas, experiences, and knowledge necessary to avoid the waste of resources, time, and effort.

First priority was given to activities or programs which concentrated

on comprehensive statewide program development and community education. The Office of Education received 1,925 proposals requesting seventy-five million dollars in support. With the available $2 million a total of 71 projects were funded, with 37 of these under $10,000. Industrial Arts personnel at all levels should request and review guidelines for the fiscal 1972 appropriation which will be available late this fall.

Industrial Arts Rationale: Technology/Ecology Relationship

Although to date the natural sciences have laid claim to most of the organized curriculum efforts directed at a study of the ecology, it is becoming increasingly obvious that no single school subject has a monopoly on the broader connotation of environmental education. We are now in an educational arena of life where man's total interrelationships with both his natural and man-made environment come to the forefront. Ecology slanted science courses, outdoor or conservation education are merely small segments of the larger EE system. It is important that each school curriculum area, in cooperation with local community resources, identify its most appropriate and unique contributions leading to the major goal of environmental literacy. This is now the current challenge for the industrial arts profession -- to decide how we can make viable contributions in environmental education and then proceed with a planned program for action.

Industrial arts is best equipped, both literally and figuratively, to concern itself with the technology dimensions of the environmental issue. One needs only to examine what EE is, what the

problems of the environment are, and what we say industrial arts, by definition,should be in order to arrive at a rationale for our inclusion in ranks of environmental educationists. We cannot pretend to interpret industry and technology to youth if our programs do not include a study of the positive and negative results of industrial organization, operation and occupations as they relate to technology's influence on the environment (7, p. 18). Pollution, for instance, is the unwanted by-product of man's interaction with technology. It is definitely related to the ways production and services industries have organized. Pollution is a problem of today's industries (as well as municipalities) that is being weighed against the benefits of high-level production and concurrent affluence. It is ultimately caused by the technological mix or the coming together of the plans, materials, tools, and processes in the absence of sufficient pollution abatement equipment. Occupationally speaking, people through their jobs help to produce pollution. However, on the other side of the coin, hundreds of industrial occupations deal specifically with process engineering, in-plant health and safety, and numerous environmental technician-type jobs that are devoted to pollution control. If you take the key words in this paragraph and arrange them in ordered sequence prefixed by "Industrial arts is . . ." you arrive our environmental mission via our purported definition. Let's face it now! What we have historically talked about "becoming" we now have an opportunity to become. It has often been said that the key to success is being around at the right time under the right set of circumstances. The call for us is to

dislodge from our rhetoric and move to the dynamic reality of bringing our industrial arts definition to life. Now is the time and the right set of circumstances are obvious. Industrial arts is inherently endowed to bring about an educational awareness of industry and technology as they relate to man and his interrelation with his environment. Congressman John Brademas, author of the Environmental Education Act in the House, sees the role of industrial arts in environmental education as follows (1, p. 142):

> The industrial arts, of course, is the discipline which has traditionally addressed man's relationship to the things he makes and uses, so it seems natural that men and women in the field should be leaders in the creation of some of these new educational forms. Both in creating new curricula for the classroom and in going out from the school to the community, people in industrial arts have an orientation to the real world which will make them invaluable in creating education for a new environment.

The remaining portions of this guide are intended to give the industrial arts teacher a directional perspective of the pollution-environment subject that will enable him to develop a local emphasis programs in enrironmental education.

## PERSPECTIVE ON POLLUTION

Environmental pollution is generally classified into the three primary areas of air, water and land (solid waste) pollution and the three secondary areas of radiation, pesticides and noise pollution. In terms of greatest public awareness, industrial concern accompanied by abatement measures, and legislative emission standards and controls air pollution ranks number one. Although water pollution presents

serious consequences to the ecological life cycle, the average tax paying citizen is likely to look beyond the polluted river or stream to the more tangible and growing problem of solid waste disposal which is known as the "3rd Pollution" in the hierachy of contaminant areas. Radiation, the use of pesticides and noise are problems that are receiving corporate and governmental attention, but they are least recognized by the populace, primarily because they cannot be observed directly. Air pollution, water pollution and solid waste usually confront us daily.

Air Pollution is chiefly caused by the burning of fuels for heat and power, industrial processing, and from the combustionable disposal of industrial and municipal wastes. The sources of air pollutants are industry, power plants burning fossil fuels, motor vehicles, space heating and refuse disposal plants (also open burning). Sulfur Oxides and particulate matter are the two major air pollutants. They account for 30 percent of the 210 million tons of waste poured into the air annually over the United States (13).

The major source of the sulfur oxides is the burning of the fossil fuels coal and oil which contain significant amounts of sulfur and give off large amounts of sulfur dioxide and lesser amounts of sulfur trioxide. Although the sulfur dioxide is a colorless, non-flammable and non-explosive gas, it is highly soluble in water and its pungent and irritating odor can be smelled and tasted in the air. Sulfur dioxide reacts with water to form sulfuric acid and sulfuric acid salts which are dangerous to the lungs and the dioxide gas irritates the upper respiratory tract.

Particulate matter are the minute pieces of solid materials which are caused by combustion and dispersed into the atmosphere. These constitute a significant portion of the pollutants in city air. Composed of bits of carbon, fly ash, oil, grease and microscopic amounts of metal and metal oxides, particulates are the dust, smoke, haze and mist that are so easily seen (13). Carbon Monoxide and hydrocarbons are discharged chiefly by the automobile. The former is noticed in heavy traffic and produces headache, loss of visual acuity and decreased muscular coordination. The chemical hydrocarbons play a major role in the formation of photochemical smog.

The major industrial contributors of gaseous and particulate air pollution are: pulp and paper mills; iron and steel mills; petroleum refineries; smelters; and inorganic and organic chemical manufacturers.

Water Pollution comes chiefly from industrial, municipal and agricultural sources. There are more than 300,000 water-using industrial plants in the United States of which the paper, organic chemicals, petroleum and steel groups discharge most of the process wastewater. Municipal wastes include domestic wastes from homes and other dwellings, and commercial establishments. A considerable amount, now slightly over 40 percent of industrial wastewater, is processed by municipal waste treatment plants. Agricultural wastes are caused by the use of chemical fertilizers containing nitrogen and phosphorus and by animal wastes which are diffused to the water. The use of pesticides also presents a water pollution problem. Point and diffuse

sources of water pollution produce sediment, nutrients, pesticides, silt, salts, oil, sewage, phenols, acids, alkalies, heat solid wastes, radioactive materials, heavy metals, bacteria and viruses, detergents, floating and settleable solids, color, organic and inorganic materials, dissolved solids, bio-chemical and chemical oxygen-demanding wastes, and toxic and inert material (8). If one were to compare industrial water pollution to municipal water pollution from organic wastes it is equivalent to the amount of municipal wastes produced by 210 million people (3, p. 104).

The quality of wastewater is often measured in terms of its biochemical oxygen demand (BOD) or the amount of dissolved oxygen that is needed by bacteria to properly decompose the wastes. Manufacturing activities, transportation and agriculture account for two thirds of all water pollution.

Solid Waste Pollution covers a growing category of unwanted, leftover substances generated in the course of producing, processing and consuming useful products. Agricultural wastes consisting of animal wastes, animal carcasses, crop residues and logging debris are the largest source of solid waste -- 2 billion tons annually. Mining and mineral processing wastes are about 1.5 billion tons a year.

Although 95 percent of all solid waste is produced in the processing of natural resources, the major problem of solid wastes disposal is the remaining 5 percent of garbage, rubbish, ashes, and municipal refuse. This paradox is due to the location of the respective sources. Resource mining occurs in sparsely populated

areas where solid wastes can be effectively disposed of, whereas the "garbage" problem is caused by and occurs in the heavily populated metropolitan and suburban areas. The growing problem of solid waste disposal is caused by increased population, increased consumer purchasing power, consumer distaste for reconstituted materials, and the tremendous increase in non-returnable items of glass, plastic and paper. The packaging industry alone accounts for 35 million tons of refuse annually.

Refuse is processed to reduce its bulk and subsequently reduce collection, storage, transportation and disposal costs. Common processes are mechanical compaction and communication, open burning, incineration, pyrolysis and composting.

## THE ROLE OF INDUSTRY

American industry is not the sole offender on the pollution scene, yet many are quick to generalize and brand all industry with the black hat syndrome. Today's affluent populace is easily influenced by negatively skewed environmental rhetoric advanced by self-styled ecologists. One should be highly selective in reading materials dealing with the environment issues. Industry is playing an increasingly expanding role in the control of pollution through the strategic application of its abundant resources, including personnel, research activities and technologies. Most larger corporations have reorganized to create environmental control departments or groups which team up with or replace existing process engineering departments. What has

prompted industry's improved emphasis on environmental control? Although many manufacturing and service industries have always been concerned about their social image and have paid close attention to maintaining pollution standards, others have not. Today those who form the latter group are also moving in the direction of increased pollution abatement programs in answer to federal and state legislation which establishes emission standards for air and water. Numerous exemplary pollution abatement programs preceded federal measures and were the result of farsighted, sensitive corporate action.

The space provided here does not permit the analysis of the far-reaching social, political and economic implications of controlling pollution, but they do exist, and you and your students will become aware of them as you embark on environmental education activities. An overview of some of the existing anti-pollution equipment and abatement technologies being used by industry will provide you with a basic orientation which will enable you to better direct your students in their study of and activities with the technology dimensions of environmental pollution and pollution control.**

Abatement Technology: Air Pollution

> Dry mechanical collectors are used to collect particulate matter and are of two general types; settling chambers and cyclone collectors.

** Taken from "Businessman's Environmental Dictionary," Industrial Ecology. (temporarily out of publication)

Settling chambers -- particulates are removed as force of gravity pulls them to the base of the chamber.

Cyclone collector -- particulates are pulled out by centrifugal force.

Wet scrubbers can remove as much as 99 percent of particulates air stream by spraying or forcing the contaminated air through a series of liquid baths.

Fabric filters operate much the same way as does a vacuum cleaner. The industrial air stream is drawn through a series of cloth or fabric bags or envelope while large dust pieces are caught in the bags.

Electrostatic precipitators are multiple units which operate by passing the air stream through a strong electric field. As gases pass through the electric field, suspended particles pick up the negative charge and are drawn to a collecting electrode. Precipitators can remove as much as 99.9 percent of all particulates.

Gaseous Control Devices

Chemical Absorbers use chemicals to suck the polluting gases from the air stream before they are discharged through the stacks.

Chemical absorbers condense the gas on the surface of a hard surface, usually carbon, before discharge.

Abatement Technology: Water Pollution

Primary water treatment includes the preliminary screening for sticks, rags, and other debris and the use of settling chambers. Although primary treatment does not improve the water quality, 30 precent of the countries municipal sewage facilities are serviced by only primary treatment systems.

Secondary water treatment consists of aerobic and anaerobic systems that cause microorganism conversion of organic wastes into carbon dioxide.

Tertiary water treatment is the most sophisticated and effective. Water is subjected to various chemicals which absorb the effluents, dissolve them, render them harmless or cause them to coagulate, settle or rise to the surface of the water where they are removed mechanically.

Distillation processes are used to separate waste from water by heating the $H_2O$ until it rises as a mist, collecting and cooling the mist which turns back to a liquid apart from the pollutants.

Electrodyalysis is the water what electrostatic precipitators are to the air. This is a form of tertiary treatment whereby effluents are separated by means of electric charges.

Reverse osmosis is used in disalinization operations and is a process that forces water through a series of membranes which prevent pollutants from going through.

Abatement Technology: Solid Wastes

Pneumatic collectors are used to draw off production line scrap or like properties to a central plant location. A duct system is used to collect the materials.

Grinders, shredders, crushers and compactors are used to reduce the volume of waste materials before they are reintroduced into the production line or disposed of.

Mechanical separators segregate various kinds of materials within the waste mix to facilitate recycling.

Incinerators are used to reduce solid waste volume. Closed incinerator systems have been introduced which use the heat resulting from the combustion process to heat buildings, thus reducing fossil fuel burning and resultant sulfur dioxide.

Pyrolysis is a form of incineration in which combustion takes place in the absence of air. This process enables a higher percentage of the wastes to be reclaimed.

In addition to the pollution abatement systems described above, numerous innovative techniques for controlling air, water and solid waste pollution are in the research and development and pilot model stages. Antipollution industries such as Research-Cottrell, Western Precipitators, Carborundum, Wheelabrator and Zurn Industries are involved in manufacturing much of abatement equipment cited (4, p. 114).

Pollution abatement equipment is expensive, especially when it has to be installed on an existing plant, what is termed in the industry as "back-fitting." The average cost per installation of a

precipitator, which you recall are usually in multiples is one and a half million dollars. Regardless of the industry, pollution abatement equipment is almost automatic in new plant development and construction. It has been estimated that the average corporate budget includes 10 percent for pollution control.

## Consulting Engineering Firms

Throughout industry environmental engineering and consulting firms are becoming very popular, especially for the smaller operation that cannot afford their own specialized equipment or environmental research groups. The role of the consulting firms will increase as industries seek expertise to identify and reveal solutions to their respective and oftentimes unique pollution problems, require hydraulic models of equipment for new facility planning, and need the advantage of a third party viewpoint for decision making or court case strategies. Many consulting firms are selling their services in the form of comprehensive air and water monitoring programs which assist the purchasing industry in maintaining local and/or federal emission standards.

## Industrial Association Functions

In addition to the role of the individual industries, industrial groups and organizations such as the National Association of Manufacturers, American Iron and Steel Association, Automobile Manufacturers Association, Society of the Plastics Industry, and the Aluminum Association have developed comprehensive programs of research, state of the

art studies, and in-house and public oriented literature designed to promote a factual awareness of the real problem of pollution. These groups will be especially helpful when attempting to secure specific information about various industrial groups. As one example, the National Association of Manufacturers has established an Environmental Quality Committee which consists of over 100 representative industries from all parts of the country. This group recently conducted a Conference on Pollution which dealt with how industry will meet the standards being established by the federal government.

National Association of Manufacturers: Environmental Quality Committee

NAM's Environmental Quality Committee was established in 1970 for the purpose of coordinating and communicating some of the pollution control efforts of member industries and providing for cooperation and liaison among those industries having similar pollution problems or employing similar abatement strategies.

Each company on the Environmental Quality Committee is represented by that corporate individual specifically in charge of environmental activities at their respective plant. Also included on the committee are representatives from environmental consulting firms and engineering services groups. Manufacturing Trade and Services Industries are represented.

Although the members of the Environmental Quality Committee are only representative of those industries involved in on-going environmental action programs they provide a good cross-section of

various kinds of manufacturing and service industries and provide a good resource listing for the industrial arts teacher or student requiring additional information about specific pollution problems pertaining to selected industrial processes or operations. Most companies are willing to share the pollution control activities with interested parties, primarily in the form of special annual reports or publications or news releases describing their corporate or local plant abatement efforts.

Although the member industries may change somewhat from year to year it appears the listing in the appendices of this guide will be useful for most general inquiries or student research requests. This is not a complete list of the over one-hundred members but rather a selected grouping that appear to have significant relevance for industrial arts applications. A complete listing of the committee is available upon request from Environmental Quality Committee, National Association of Manufacturers, 277 Park Avenue, New York, New York 10017.

The Role of Government

Although government involvement on the environment issue has been primarily through state and federal legislation which establishes pollution emission standards for industry and municipal sources, there do exist a number of less publicized programs and activities dealing with pollution control that are making themselves felt in the National anti-pollution effort. Generally speaking, the government's role

consists of establishing legislation, enforcing legislation, sponsoring federal grants and loans to carry on industrial pollution control programs as well as research in the areas of pollution abatement, and conducting numerous public awareness programs through publications, speaker services, films and other releases. Most of these programs are carried on by specific environmental offices or groups within the larger Federal-State structures.

Beginning with President Nixon's National Environmental Policy Act of 1969 (PL 91-190, January 1, 1970) which set the stage for the National priority on the environment and established the President's Council on Environmental Quality, the Federal Government has taken an active and increasingly effective role in improving the quality of the environment. In 1970 the Environmental Quality Improvement Act (PL 91-224, April, 1970) and two major reorganization plans were included among numerous Federal action programs. The reorganization plans consolidated hundreds of heretofore separated and independent functioning offices and agencies dealing with the environment. The Environmental Protection Agency, a workhouse regulatory group, was a result of the overall organization. This synthesis has provided a powerful, concerted and coordinated impact of improving the environment, thus moving towards the accomplishment of the reorganization goal. Business is generally in favor of government regulatory activities and Federal standards but emphasizes the need for realistic and economically feasible emission controls.

President's Council on Environmental Quality

On January 1, 1970, President Nixon signed into law the National Environmental Policy Act. Known as Public Law 91-190, the act established a national environmental policy and provided for the establishment of the Council on Environmental Quality.

The President's Council On Environmental Quality is an advisory group that coordinates all Federal environmental quality programs and constantly reviews other Federal programs that may have environmental implications. The Council conducts investigations, studies, surveys, research, and analyses relating to environmental quality the results of which they use to develop and recommend to the president's national environmental policies (6, p. 20). Utilizing the services, facilities and information available from public and private agencies and organizations, the Council on Environmental Quality prevents overlapping and conflicting efforts and expenses that would result from duplication of services. Title I of the Act is a declaration of the National Environmental Policy while Title II deals with the establishment and function of the Council on Environmental Quality (hereinafter Council). Sections 204 and 205 of Title II of Public Law 91-190 present the duties, functions, and responsibilities of the Council. They are (6, p. 248):

> Sec. 204. It shall be the duty and function of the Council --
>
> (1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201;
>
> (2) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are

likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in Title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the national environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

Sec. 205. In exercising its powers, functions, and duties under Act, the Council shall --

(1) consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order numbered 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and

(2) utilize, to the fullest extent possible, the services, facilities, and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be

> avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

In effect, the President has charged the Council with the role of coordinating all Federal environmental quality programs and reviewing other Federal Programs which have environmental implications.

Part of the responsibility of the Council on Environmental Quality is to prepare an annual ENVIRONMENTAL QUALITY REPORT which identifies the status and condition of the Nation's environment. Transmitted to the Congress by the President, this Report, according to section 201 of the Act (Public Law 91-190), shall trace current environmental trends and the adequacy of natural resources to fulfill human and economic needs. It shall review programs and activities of Federal, State, and local governments and of how government entitles on individuals, detailing the effects on the environment, and it shall suggest ways of remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

Chairman of the three-man Council on Environmental Quality is Russell E. Train, former Under-Secretary of the Interior, who also served as chairman of a special task force on environmental problems following the 1968 election. Under Mr. Train's direction, Mr. Robert Cahn, and Dr. Gordon MacDonald, the other Council member, and the professional, administrative, and annual report staff have done exhaustive research and compiled its findings in "THE FIRST ANNUAL REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY". This report is priority reading for any citizen desiring a general, yet conclusive, account of the Nation's

environmental status and especially good background information for the public school or university teacher desiring to include areas environmental education in the curriculum.

The contents of THE REPORT are prefaced by President Nixon's transmittal message and appendicised by the National Environmental Policy Act of 1969, the Environmental Quality Improvement Act of 1970, and selected Presidential messages including the Federal Reorganization Plans.

The following main topics of THE REPORT are taken from the Table of Contents to reveal the scope of ENVIRONMENTAL QUALITY:

I. Understanding Environmental Problems
II. Federal Organization for Environmental Quality
III. Water Pollution
IV. Air Pollution
V. Man's Inadvertant Modification of Weather and Climate
VI. Solid Wastes
VII. Noise, Pesticides, and Radiation
VIII. Population, Growth, and Resources
IX. Land Use
X. International Cooperation
XI. Citizen Participation
XII. Environmental Education
XIII. Present and Future Environmental Needs

THE FIRST ANNUAL REPORT of the Council on Environmental Quality is included in the "Environmental Resources" (Government Publications) section of this guide and is highly recommended for providing more detailed information regarding this Council and other dimensions of the Federal Government's involvement control and regulation.

Federal Reorganization

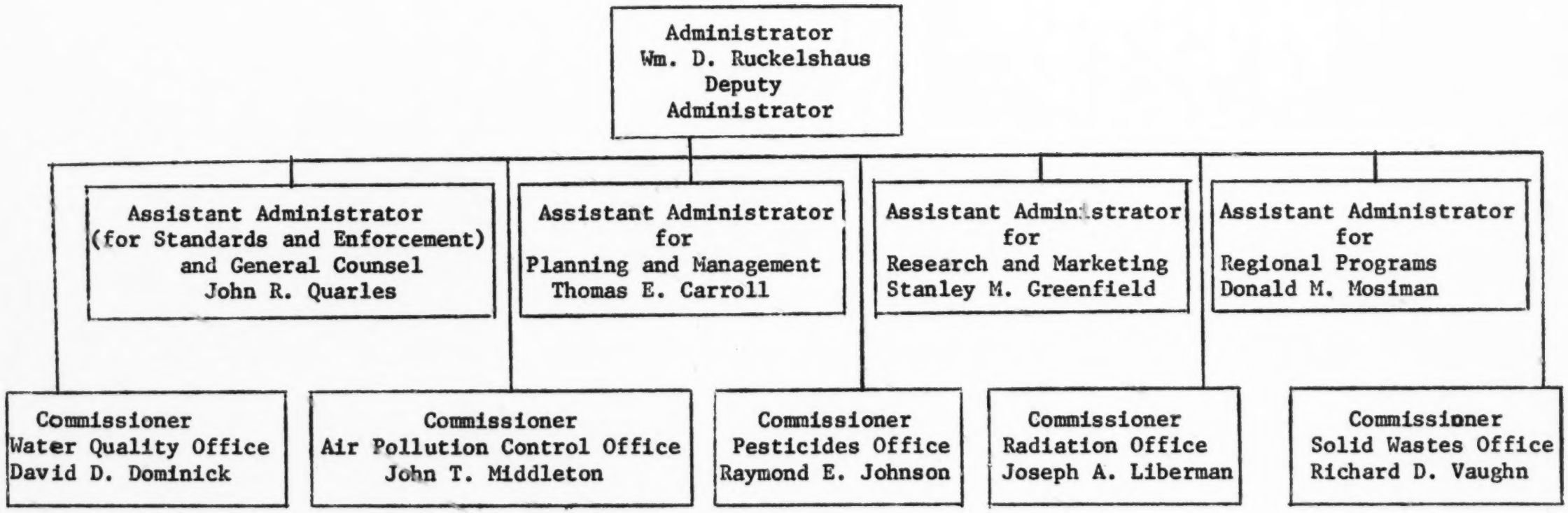
Realizing that a fragmented approach to dealing with major

pollution control problems would make it difficult for the Federal Government to effectively enforce its regulations, President Nixon, in his 1970 Message on the Environment recommended organizational reforms. In his July 9, 1970 Message to Congress, the President transmitted two reorganizational plans that would ultimately consolidate pollution control agencies and marine and atmospheric programs into the Environmental Protection Agency and the National Oceanic and Atmospheric Administration respectively. (6, p. 24).

The Environmental Protection Agency (EPA), is a Federal regulatory agency. Headed by William D. Ruckelshaus, it combines fifteen separate Federal Divisions into a unified coordinated enforcement agency. The structure of EPA, as shown in figure 1, welds the legislative authorities and abilities of the following Federal agencies: the Federal Water Quality Administration, previously in the Department of Interior; the National Air Pollution Control Administration, previously in the Department of Health, Education, and Welfare (HEW); the Bureau of Solid Waste Management, previously in HEW; a Radiation Office and a Pesticides Office.

EPA's annual $1.4 billion budget enables close to 6000 Federal personnel to deal with significant problems, many involving pollutants which find their way into air, land, and water. The roles and functions of the Environmental Protection Agency are clearly stated in President Nixon's Message to the Congress relative to his Reorganization Plans of July 9, 1970 (6, p. 299).

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460




APPROVED: DECEMBER 4, 1970

FIGURE 1

Roles and Functions of EPA

The principal roles and functions of EPA would include:

-- The establishment and enforcement of environmental protection standards consistent with national environmental goals.

-- The conduct of research on the adverse effects of pollution and on methods and equipment for controlling it, the gathering of information on pollution, and the use of this information in strengthening environmental protection programs and recommending policy changes.

-- Assisting others, through grants, technical assistance and other means in arresting pollution of the environment.

-- Assisting the Council on Environmental Quality in developing and recommending to the President new policies for the protection of the environment.

The exact nature of assistance provided to the President's Council on Environmental Quality by the EPA would be one of establishing and enforcing those pollution control standards resulting from the advisory/policy-making roles of the Council. In turn, the council serves an equally important function in directly advising the President and in coordinating many of the EPA's activities.

The Environmental Protection Agency has brought legal action against long lists of industries in violation of water quality, air pollution and pesticide standards. In some cases pollution standards and subsequent pollution abatement orders run the risk of closing industries and causing unemployment. The EPA is assuming an active role in attempting to find ways for these threatened plants to get emergency loans and meet the high priced abatement specifications.

Under the 1899 Refuse Act, as of July, 1971, all United States industries wishing to dump effluent into the waterways must apply for

permits to do so from the U. S. Army Corps of Engineers. To receive the permits the process wastewater effluent will have to meet federal and state water quality standards which will ultimately be monitored and checked by EPA.

The efforts of the Environmental Protection Agency have shown praiseworthy results undoubtedly due to the synthesising nature of combining previously disjointed federal departments dealing with various phases of the environment. Increased financial and human resources will continue to increase the effectiveness of this federal agency in regulating the operational standards and pollution abatement programs of American Industry.

The National Oceanic and Atmospheric Administration

As was the case leading to the establishment of the Environmental Protection Agency, so also there existed with the federal structure numerous departments and agencies that dealt with the oceanic and atmospheric conditions of the environment. The National Oceanic and Atmospheric Administration (NOAA) forms a single body concerned with administering Federal programs dealing with the seas and the atmosphere. Established within the Department of Commerce, NOAA had an approximate 1971 budget of 270 million and over 12,000 personnel. According to a July 9, 1970 fact sheet from the White House Press Secretary, NOAA consists of the following:

1. The Environmental Science Services Administration (also previously part of the Department of Commerce).
2. Most of the Bureau of Commercial Fisheries (previously in the Department of Interior).

3. The Marine Minerals Technology Program of the Bureau of Mines in the Department of the Interior.

4. The Marine Sports Fishing Program of the Bureau of Sport Fisheries and Wildlife in the Department of Interior.

5. The Office of Sea Grant Programs of the National Science Foundations.

6. Elements of the United States Lake Survey of the Department of the Army.

The National Oceanic and Atmospheric Administration has and will continue to function with the central purpose of increasing understandings of oceanic and atmospheric resources.

The Council on Environmental Quality, the Environmental Protection Agency and the National Oceanic and Atmospheric Administration represent the three pronged attack on pollution and environmental quality. The result of a major Federal reorganization plan, these new agencies have already proven the structure change an effective one and will continue to play a major role in maintaining the quality of the environment through establishing, regulating and enforcing appropriate plans and programs to halt pollution.

## The National Industrial Pollution Control Council

The National Industrial Pollution Control Council (NIPCC) was created by the President (Executive Order 11523) on April 9, 1970, as part of the federal reorganization for environmental quality. NIPCC therefore functions with regular Government personnel support from the Department of Commerce and transmits all reports of findings to the

President through the Secretary of Commerce. The Industrial Council is therefore an advisement group to the President and to the Council on Environmental Quality regarding pollution control and abatement policies and programs involving or affecting industry and achievement of the Nation's environmental goals. The activities of the NIPCC are derived from its basic assignments as presented in the President's order. These assignments are (14, p. 5):

1. To provide advise to the President and the Chairman of the Council on Environmental Quality, through the Secretary of Commerce, on request on matters involving or affecting industry policies and programs relating to pollution control and abatement.

2. To volunteer advise at the initiative of the Industrial Council to the President and the Chairman of the Council on Environmental Quality, through the Secretary of Commerce, on matters involving or affecting industry policies and programs relating to pollution control and abatement; and

3. To stimulate efforts by industry toward achievement of the Nation's environmental goals.

NIPCC Organization

The Industrial Council is organized to function within a "Types of Industry" framework rather than a more general "Types of Pollution" approach. Thirty Sub-Councils were established which closely alligned with the organization of the engineering, mining, manufacturing, and goods distribution enterprises of the American industrial economy. Further identification of each type of enterprise activity resulted in assigning each sub-group of NIPCC the responsibility of researching the pollution control and abatement

problems of their respective area and to provide advice and recommendations on any environmental policy or program which specifically affects their enterprise activity. Each Sub-Council is composed of representatives of member enterprises and serve at their own expense and arrange privately for additional research and report preparations. The following listing of the Sub-Councils and respective chairmen provides a picture of the range in industrial areas involved and also identifies a contact for those teachers desiring specific Sub-Council information. A complete listing of all Industrial Council and Sub-Council members is available in the February 1971 COUNCIL REPORT.

National Industrial Pollution Control Council

Listing of Sub-Councils and Chairmen:

Airlines & Aircraft Sub-Council
Charles C. Tillinghast, Jr. Chm.
Trans-World Airlines, Inc.

Automotive Sub-Council
E. N. Cole, Chairman
General Motors Corporation

Beverages Sub-Council
Donald M. Kendall, Chairman
Pepsi Company, Inc.

Building Materials Sub-Council
Cris Dobbins, Chairman
Ideal Basic Industries, Inc.

Chemicals Sub-Council
Birny Mason, Jr. Chairman
Union Carbide Corporation

Coal Sub-Council
John Corcoran, Chairman
Consolidation Coal Co., Inc.

Construction Sub-Council
Bertram L. Perkins, Chairman
Morrison-Knudsen Co., Inc.

Containers: Cans Sub-Council
William F. May
American Can Company

Containers: Glass & Plastic Sub-Council
Edwin D. Dodd, Chairman
Owens-Illinois, Inc.

Containers: Paper Sub-Council
Leo H. Schoenhofen, Chairman
Container Corporation of America

Detergents Sub-Council
Howard J. Morgens, Chairman
Proctor and Gamble Company

Electric and Nuclear Sub-Council
Donald C. Burnham, Chairman
Westinghouse Electric Corp.

Fertilizers and Agricultural Chemicals Sub-Council
Clifford D. Siverd, Chairman
American Cyanamid Company

Food: Dairy, Fish & Other Sub-Council
C. W. Cook, Chairman
General Foods Corporation

Food: Grain-Based Products Sub-Council
James P. McFarland, Chairman
General Mills, Inc.

Food: Poultry & Animal-Based Products Sub-Council
Robert W. Reneker, Chairman
Swift and Company

General Manufacturing Sub-Council
Alexander H. Galloway, Chairman
R.J. Reynolds Industries, Inc.

Heavy Equipment Sub-Council
Arthur J. Santry, Jr., Chairman
Combustion Engineering, Inc.

Leisure Sub-Council
Ralph Evinrude, Chairman
Outboard Marine Corporation

Mining and Non-Ferrous Metals Sub-Council
Frank R. Milliken, Chairman
Kennecott Copper Corporation

Paper Sub-Council
Karl R. Bendetsen, Chairman
U.S. Plywood-Champion Papers, Inc.

Petroleum and Gas Sub-Council
J. K. Jamieson, Chairman
Standard Oil Company (New Jersey)

Process and Systems Engineering Sub-Council
Stephen D. Bechtel, Jr., Chairman
Bechtel Corporation

Railroads and Rail Equipment Sub-Counci;
Benjamin F. Biaggini, Jr., Chairman
Southern Pacific Company

Rubber Sub-Council
Russell DeYoung, Chairman
Goodyear Tire & Rubber Co.

Shipping Sub-Council
Frank A. Nemec, Chairman
Lykes-Youngstown Corp.

Steel Sub-Council
Edmund F. Martin (Retired), Chairman
Bethlehem Steel Corporation

Utilities Sub-Council
Shermer L. Sibley, Chairman
Pacific Gas & Electric Co.

Wholesale, Retail and Services Sub-Council
Arch N. Booth
U.S. Chamber of Commerce

NIPCC Sub-Council Work

All of the Sub-Councils have been engaged in activities to identify the special pollution and abatement problems of their respective industrial area. They have determined the state of progress which the industry has reached technologically, economically, and operationally to achieve the pollution standards and regulations currently enforced. The Industrial Council found itself limited because of the lack of information about industrial environmental problems. As a result, NIPCC has prompted industrial organizations and associations to initiate programs to collect and disseminate more accurate data regarding industrial pollution control and abatement activities.

The Industrial Council has urged support from both industry and government in developing and implementing effective pollution abatement programs. Among the areas needing study and clarification are: The precise definitions of pollutants, an agreement on pollution on measurement techniques, the need for uniform accounting practices for compilation of capital and operating costs attributable to pollution abatement and control, and the need for a system of information exchange about what is being done in the way of pollution control and abatement research, demonstrations and practical achievement. In September, 1970, The National Technical Information Service (NTIS) was created in the Department of Commerce to develop such an approach to information exchange. In brief, the system links the more than two-hundred science and research information data bank durrently operated by public and private organizations. The NTIS goal is to

expedite industrial efforts to achieve efficient pollution control and abatement programs.

The National Center For Solid Waste Disposal, Inc.

An ad hoc study group of NIPCC studying the problems of solid waste disposal and litter control recommended that industry use a collaborative approach towards dealing with these problems. It was as a result of this study groups findings and recommendations that the National Center For Solid Waste Disposal, Inc. was created by a number of industries which together would sponsor research and demonstrations in solid waste disposal and litter control systems. The following exerps taken from the letter written by Donald M. Kendall, President of Pepsi Company, Inc. and Chairman of the Board for the National Center, to Russell Train, Chairman of the President's Council on Environmental Quality, provide a good account of the Center's mission. Mr. Kendall explains (14, p. 50):

> . . . It is our belief that industry is responsive to the implications of the packaging explosion. However, it is apparent that the effects of our research and efforts in the field of recycling, materials reclamation, and solid waste management may be diluted and rendered far more expensive, if not impossible, without the free interchange of information and experience within industry. This exchange accompanied by a <u>total systems development approach</u> offers the best prospect for achieving solutions to our solid waste management problems.
>
> The systems approach embraces many areas of interest: consideration of reclamation and reuse of products, changes in distribution and marketing patterns and procedures, consumer education and alteration of behavioral patterns and new product packaging and materials development are some of these. But to be truly effective, it must go further.

It must define the manner in which our present waste collection and disposal system functions within the total environment. It must isolate its weaknesses and develop corrections for them. It must, ultimately, propose systems which are compatible with the physical requirements of the American life style.

Obviously, all this is an undertaking too vast to be assumed by any single agency, company, or industry. Therefore, because of problems, scope and complexity, the steel, aluminum, glass, metal can, paper, plastics, soft drink, brewing, supermarket and chain store, food canning, and food processing industries have come together in joint sponsorship of the National Center for Solid Waste Disposal, Inc. Its mission is four-fold:

1) To serve as a resource agency for information on litter and solid waste management systems.

2) To function as an agency to receive funds from private and public sources for the support of research.

3) To contract out research grants for the development of litter control and solid waste management systems.

4) To obtain and evaluate the results of research in litter control and solid waste management and to utilize those results in the design, test, and implementation of systems of litter control and solid waste collection, recycling, and disposal.

> The Center will function as a central communications point for government agencies, industries, individuals, and private institutions involved in the many aspects of litter prevention, solid waste collection, recycling and disposal. Not only will it collect, develop and disseminate information and facts, but it will also possess and exercise a capability for coordinating internal and external expertise in designing, operating, and evaluating solid waste management systems. (14, p. 50)

The National Center for Solid Waste Disposal, Inc. is run by a Board of Directors consisting of primarily presidents, vice-presidents, or general managers of packaging producing and package using industries.

NIPCC Recommendations

Although a more detailed account of the work and findings of the National Industrial Pollution Control Council is available to the reader through the first Council Report, it is worthwhile to briefly identify some of the major areas studied and the recommendations advanced. (14, p. 10)

POLLUTION CONTROL AND COMPETITION

We urge that pollution controls be based on evidence of reasonable likelihood of harm to man and his environment.

We urge an orderly approach to adoption of soundly based pollution control standards under strong federal leadership.

THE INTERNATIONAL ENVIRONMENT

A massive industry/government collaboration is urgently needed to assure the prompt and effective achievement of international environmental accords.

ENVIRONMENTAL ECONOMICS

As a matter of principle, the right to pollute the environment should never be "For Sale."

The Industrial Council lists the following environmental economic observations (14, p. 13):

1. Some enterprises such as those with limited access to new capital either because of small size or low return on investment, may need assistance in meeting pollution control and abatement requirements.

2. In the new environmental economic framework, the general objective should be a full statement of the cost consequences of the avoidance of environmental degradation in the competitive cost/price structure. With proper attention to the time frame within pollution control ob-

jectives are to be attained and with appropriate international accord, it should be possible to complete the transition to this full reflection of pollution control costs without permanent subsidies.

3. User or service charges for coordinated or centralized systems to clean up the environment may prove to be the most effective approach in some situations. Environmental taxes, on the other hand, are a deceptively attractive new source of public revenues. Sale at auction or otherwise, for example, of permits or certifications for the right to pollute would introduce a new competitive cost element in the enterprise system. It could also be counter-productive to achievement of environmental goals by stimulating industrial growth in areas not now environmentally-impaired. Once initiated, this new revenue device would tend to perpetuate pollution since, historically, new sources of revenue are rarely abandoned.

NIPCC Publications

The preceding information about the National Industrial Pollution Control Council was taken from the COUNCIL REPORT of January 1971. COUNCIL REPORT, the first staff report (mercury) and following Sub-Council reports are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402:

"Acid Mine Drainage" - Coal Sub-Council - 20¢
"Animal Slaughtering and Processing" - Food: Poultry ¢ Animal-Based Products Sub-Council - 20¢
"Deep Ocean Dumping of Baled Refuse" - Process & Systems Engineering Sub-Council - 20¢
"Exhaust Emissions from Gas Turbine Aircraft Engines" - Airlines & Aircraft Sub-Council - 30¢
"Glass Containers" - Containers: Glass & Plastic Sub-Council - 25¢
"Mathematical Models for Air Pollution Control Policy Decision-Making" - Process & Systems Engineering Sub-Council - 30¢
"Noise from Gas Turbine Aircraft Engines" - Airlines & Aircraft Sub-Council - 30¢

"Self-Analysis of Pollution Problems" - Electric and Nuclear Sub-Council - 30¢
"Regionally Consolidated Industrial Wastewater Treatment" - Process & Systems Engineering Sub-Council - 30¢
"Waste Disposal in Deep Wells" - Process & Systems Engineering Sub-Council - 25¢
"Wood Products" - Wood Products Sub-Council - 25¢
"Air Pollution by Sulfur Oxides" - Staff Report - 20¢
"Animal Wastes" - Staff Report - 20¢

Reports previously submitted are:
"Detergents" - Detergents Sub-Council - 20¢
"Junk Car Disposal" - Automotive Sub-Council - 40¢
"Mercury" - Staff - Staff Report - 20¢

Another publication of NIPCC has been a Casebook of Pollution Cleanup Actions consisting of published accounts of individual company environmental accomplishments throughout American industry. Since the Casebook is not for public distribution, numerous selected pages are included in this resource guide for the purpose of acquainting you with a cross-section of illustration of what industry has done to improve the environment and to eliminate or control pollution. They are located in the Appendices.

Federal Legislation Dealing with Environment

The Federal Government has and apparently will continue to play an active role in improving the quality of the environment through standards enforcement, technical and financial assistance, research and numerous other programs through legislation. Following is a listing and description of some of the Federal legislation in the areas of water, air and solid waste pollution.

Water Pollution Legislation

The Refuse Act of 1899 provides fines and criminal sanctions for dumping wastes into navigable waters without a permit. The Army Corps of Engineers has exercised such action on polluters.

The Federal Water Pollution Control Act of 1956 was the first water pollution control legislation. It authorized planning technical assistance, grants for State programs, and construction grants for municipal waste treatment facilities. 1961 amendments extended Federal enforcement authority and increased construction grant authorizations.

1965 amendments established the Federal Water Pollution Control Administration which replaced the programs previously in the Public Health Service of the Department of Health, Education, and Welfare. In 1966 FWPCA became part of the Department of Interior.

The Clean Water Restoration Act of 1966 provided additional federal funds for waste treatment facilities.

The Water Quality Improvement Act of 1970 renamed the agency the Federal Water Quality Administration (FWQA). The FWQA provides controls on oil pollution, vessel pollution, and pollution from Federal activities as well as generally expanding the previous legislation. Requires permits for discharging effuvents. It requires applicants for the Federal permits to file certification from its state or interstate pollution agency that it does meet the water quality standards.

Water Quality Standards

The 1965 amendments to the Federal Water Pollution Control Act established water quality standards which concurrently demanded that the states establish water standards which would be approved as Federal standards by the Department of Interior. The states, therefore, are the enforcers of the varying water quality standards, backed up by the Secretary of Interior who approves and also enforces standards if the states fail to do so. In many instances where state standards are not high enough to meet Federal requirements they are only approved in parts and plans for any negotiation are conducted to raise the standards. The states are now required to establish specific effuvent discharge requirements as a part of their standards. Therefore, specific standards are available with which the industries and municipalities must comply.

Enforcing Water Quality Standards

State and Federal enforcement of water quality standards has had a definite impact on the Nation's attempt to clean up and maintain its water resources. Various states have landed hard on polluters. Under the Water Quality Act of 1965 the Secretary of Interior, in August, 1969, initiated its action against alleged violators of the standards by ordering them to meet the standards (decreased pollution) within 180 days or face court action. Those violators complied and court action was averted. Many similar water quality law suits have followed. Unfortunately because some industries and municipalities

are unable to meet the standards the courts are full of legal cases to be heard.

Air Pollution Legislation

July 1955 - first Federal legislation dealing exclusively with air pollution. It authorized $5 million annually to the Public Health Service of HEW to be used for research, data collection, and technical assistance to state and local governments.

Clean Air Act of 1963 - It provided grants to air pollution agencies for control programs and Federal enforcement authority to attack interstate air pollution problems.

1965 Amendment to the Clean Air Act provided for the regulation of air pollution on new motor vehicles. Beginning with the 1968 models standards for vehicular emission were enforced and have been increased each succeeding year. The Automotive Industry has been told by the Federal Government that it must provide a pollution free automobile by 1975.

Air Quality Act of 1967 developed a regional approach to establishing and enforcing Federal-State air quality standards. This new approach includes (6, p. 73):

1. The Secretary of HEW first must designate air quality control regions within a state or within an interstate region.

2. The Secretary must promulgate air quality criteria, which based on scientific studies, describes the harmful effects of an air pollutant on health, vegetation, and materials. He must issue control technology,

documents showing availability, costs, and effectiveness of prevention and control techniques.

3. In the designated regions, the states must show willingness to establish air quality standards.

4. The states then set standards limiting the levels of the pollution described in the criteria and control technology documents. If the states fail to do this, the Secretary is empowered to set the standards.

5. After the states have developed air quality standards, they must establish comprehensive plans for implementing them. (These plans should set specific emission levels by source and a timetable for achieving compliance.)

In 1970 President Nixon proposed legislative improvements to the Air Quality Program that extended the application of national standards to include the entire Nation and not just the air quality control regions established by the Air Quality Act of 1967. States are to submit their plans to meeting the national standards and where these air quality standards fall below Federal requirements or the state plan is simply not being carried out, the Federal Government would take over. Also included in the 1970 proposal was the establishment of national emission standards for new pollutants. These standards apply to existing and new stationary sources for pollutants extremely hazardous to health. Federal enforcement authority includes fining those not complying with the standards as much as $10,000 a day.

In February, 1969 the Department of HEW issued documents on air quality criteria and abatement procedures for sulfur oxides and particulate matter. This action prefaced the setting of standards for these two pollutants. In March 1970, criteria and control documents were issued for carbon monoxide, hydrocarbons, and photo-chemical

oxidants. Similar documents on lead, nitrogen oxides, fluorides and polynuclear organic compounds followed early in 1971.

Air quality regions now number 90, with at least one region in each state. Under this structure the states submit their standards to the Department of HEW and if approved, implementation plans are submitted for approval. The National Air Pollution Control Administration (NAPCA) as a part of the Environmental Protection Agency (EPA) continues extensive study of pollutants to determine any potential health effects. Special Federal abatement actions are presented in the Council on Environmental Quality's First Annual Report (ENVIRONMENTAL QUALITY) listed in the resource (Government Publications) section of this guide. Details of the operation of the NAPCA were presented previously in conjunction with the Environmental Protection Agency.

## Solid Waste Legislation

The Solid Waste Disposal Act of 1965 was the first Federal legislation dealing with the solid waste problem previously dealt with by the local governments. This act gives the Federal Government, more specifically the Bureau of Solid Waste Management (EPA), the responsibility of researching, training, demonstrating new pollution abatement technologies, providing technical assistance, and providing grants for state and interstate solid waste planning programs. This Act concentrates on research related to conserving natural resources by reducing wastes and unsalvageable materials and by the recovery of solid wastes.

The Resource Recovery Act of 1970 was an Amendment to the Solid Waste Disposal Act which provided technical and financial assistance for the construction of solid waste disposal and resource recovery facilities, improved research and development programs in management techniques, improved methods of collection, separation, recovery and recycling of solid wastes, and the safe disposal of nonrecoverable wastes, and provided for training grants in occupations involving the design, operation, and maintenance of solid waste disposal systems.

Noise, Pesticides and Radiation Legislation

As mentioned earlier in this Resource Guide the areas of noise and radiation pollution and pesticides will not be treated in any detail. The resulting problems in these important but less critical areas of pollution have likewise not received as much attention from the Federal Government in terms of legislation. There are, however, a number of notable actions and developments that have taken place within the environmentally-operating restructuring that you may wish to make note of. These can be found in a number of the respective Federal Publications listed and in more concise form in ENVIRONMENTAL QUALITY, the 1970 Annual Report of the Council on Environmental Qualtiy.

## DIRECTION: INDUSTRIAL ARTS ENVIRONMENTAL EDUCATION

The previous portions of this guide were intended to serve a twofold purpose: first, to sensitize industrial arts personnel to the need and applicability of becoming involved in the national environmental education movement, and second, to provide a brief but comprehensive orientation to the specific aspects of the environmental issue that gives credence, rationale and content implications for industrial arts to assume a leadership position in dealing with the industrial/technological dimensions of the environment. The remainder of the guide will suggest some general direction and operational guidelines for the industrial arts teacher to consider as he begins designing environmental education curriculum activities for his students. It will also present sources for environmental literature and instructional materials, an environmental glossary and a selected environmental reading list.

### Need for Pedagogical Caution

A few words of caution are appropriate here. Some of us may be inclined to organize some of the "environmental facts" into a series of neat, easily administered related lessons that have little bearing on what our students are actually doing. Others may have students build planters or bird feeders under the guise of "ecology projects." Still other teachers may attempt to devise what they see as the type of activities that could be easily accomplished by their students in

the shop with existing materials and hardware. Remember there is a difference between environmental education reflecting the study and interaction with the industrial and technological problems, procedures and benefits as they relate to pollution and pollution abatement and "conservation or outdoor education." Let others in the school program handle this. The industrial arts setting, with its resources for having students actively involved - in simulated or actual bench models with those things that make up the technology that both causes and controls industrial pollution problems, is but the beginning of an open-ended program that can bring kids in contact with real problems and real meaningful challenges.

Bear in mind that for environmental education to be effective it must be designed to make students aware of the significant impacts of technology on their lives, both negatively and positively. There is no better way for this "environmental awareness" to come about than to have your students select specific industries related to their class, i.e., lumbering industry in woods, aluminum or steel processing industries in metals, power producing industry in electricity, automobile industry in power mechanics, and have them investigate the respective pollution problems related to this industry as well as the industry's abatement policies and practices. Using a group or class approach the students will find local industries very willing to share their resources and personnel in helping the youth investigate, research, analyze, and otherwise examine specific corporate pollution problems and respective controls. There are opportunities for students to construct replicas, working models and pilot miniatures of existing

or student-conceived innovations in pollution abatement equipment.

The role of the individual student project can also be very important. Students can select problem/solution areas for individual pursuit in which they would research their topics independently and apply problem solving and planning techniques toward the development and construction of some sort of representation of the study area. The enthusiasm of students to get involved with real issues and problems that they see, taste, smell, hear or otherwise sense is an exciting experience for both them and their teachers. Teaching and learning becomes a joint adventure with real purpose. Dr. Lee Smalley, in the October, 1970 issue of IAVE, suggests a number of environmental activities appropriate for the industrial arts setting (15, p. 38). Special notice should be made of the cooperative activities possible among the industrial arts classes and other school subjects. The extent and nature of environmental activities and concepts in the lab are limited only by the creativity and interest of the students and teachers.

## Process Education A Must

Environmental Education in industrial arts will be best accomplished through process education approaches such as those advanced by Dr. Donald Maley and his colleagues at the University of Maryland in their recently proposed and currently piloted new senior high school industrial arts program which emphasizes the exploration of the application of technology in the solution of major social, environmental and operational problems facing mankind (11, p. 146).

The well known processes of the "Maryland Plan", the group project, the unit approach, and research and experimentation are utilized in the "senior high program" and emphasizes individual student inquiry and has a major thrust on the development and growth of the individual as he or she considers such topics as pollution, power generation, housing, transportation, communications, resource utilization, and industrial production (10, p. 19). Dr. Maley's "Program of Relevance . . . for a Dynamic Age" is exemplary in focusing the attention of the practitioner on the human components of the living-learning process while bringing the content of industrial arts alive with new realities and significance.

Expanding The Learning Environment

Renewed emphasis should be placed on the field trip or industrial visit as an invaluable educational tool for putting the students where the action is. You can tell your students what a precipitator is, you can prepare diagrams or slides, but until they are face to face with this pollution abatement technology and actually see it in operation, it is still secondhand knowledge. Perhaps as a part of their study the students will make individual visits to local plants to talk with key environmental personnel and gather information for their project. Many industries have prepared programs for schools, civic clubs, etc. that are applicable for the industrial arts setting. You will find most industry cooperative and interested in being a part of any educational effort that seeks to present facts about

pollution which are often lost in the cloud of emotional rhetoric. You can secure scores of good booklets and pamphlet-type literature from corporate and governmental agencies, many in classroom quantities, which will vividly illustrate what is being done about industrial pollution.

## The Industrial Arts Eco-Action Teams

Many local environmental problems, especially those that have developed from poor solid waste management by citizens and community, provide opportunities for students to become actively engaged in real problem solving. The industrial arts facilities become the hub of an action-oriented program that extends throughout the entire school, involving students for any other class which could contribute to the specific projects. While studying "in-school" or community environment problems, these teams of students would conduct field research by visiting industrial and municipal plants and treatment facilities, conduct experiments, design and build operating pieces of "pollution cleanup" or monitoring equipment, conducts specific community or school campaigns for positive environmental action, and prepare displays for school and community use which communicate the nature of local pollution control measures. Here are excellent opportunities for science and industrial arts classes to work together, for important communication materials to be jointly developed and printed by English/business/industrial arts coops, for industrial arts and art students to jointly design and develop eco-action posters fostering an "environmental

awareness" within the community. Students in power mechanics or automotive courses could conduct "vehicle pollution checks" which would pinpoint needed care and maintenance to prevent excessive air pollution.

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INDUSTRIAL ARTS ENVIRONMENTAL EDUCATION

RESOURCES

FILMED FROM BEST AVAILABLE COPY

Annual Reports With Environmental Emphasis

Annual Reports, although they do not usually devote space for detailed explanations of an industry's environmental action, they do offer the reader a composite of the company's organizational structure, products or services, and general yearly operation. For the industrial arts teacher this information becomes a valuable resource and tool for understanding the nature of an industry prior to examining its particular pollution problems related to its processes and its application of engineering and technology toward the solution of its pollution problems. Annual Reports are written for the stockholders and are therefore usually general statements of corporate policy and operation. They are easily read and understood by junior and senior high students, and the annual report concept can be made meaningful to the elementary student.

A good cross-section of Annual Reports from representative industries alligned with the industrial arts study area is recommended. For example, if you teach metals Annual Reports from U.S.S., Reynolds Metals, Alcoa, and other similar or related metals industries should be in the industrial arts resource center.

Educational Publications

ENVIRONMENT AND THE SCHOOLS: PIONEER PROGRAMS SET THE PACE FOR STATES AND DISTRICTS is a 55 page special report by the Editors of Education U.S.A. that describes the philosophy and objectives of environmental education as compared to the more traditional conservation education. Exemplary state and local school district programs are examined and explained. These are accompanied by "teaching techniques," listing of new national environmental programs, guides for establishing school programs, and a summary of the Environmental Education Act. Request by title and stock #411-12782 from the National School Public Relations Association, 1201 16th Street, N.W., Washington, D.C. 20036. Price $3.20 per copy.

ENVIRONMENTAL EDUCATION IN THE PUBLIC SCHOOLS is also a special 1970 report document prepared by the Research Division of the National Education Association for the National Park Service of the U.S. Department of the Interior. The 72 page publication reports the results of the first national survey of public school programs in environmental conservation and outdoor education. The data therein is valuable for the educator seeking a thorough knowledge and understanding of programs in these three areas but offers little in the way of guidelines or techniques for implementation of environmental concepts. Good for the "Environmental Reference Library" ENVIRONMENTAL EDUCATION IN THE PUBLIC SCHOOLS can be ordered from NEA, Publications Sales Section, 1201 16th Street, N.W., Washington, D.C. 20036, stock #435-25450, price $1.50.

Environmental Studies Series, The Addison-Wesley, (AIR POLLUTION, WATER POLLUTION, and NOISE POLLUTION). These three books are excellent for use as texts or reference by students during environmental units or activities related to the respective contaminant areas. They are well-illustrated and present a clear picture of pollution problems as well as suggested lab activities that deal with pollution abatement. These books are especially applicable for the middle or junior high school student. When ordering, request "Environmental Studies Series" from Addison-Wesley Publishing Company, Inc., Sand Hill Road, Menlo Park, California 94025 (Price unknown).

MAN AND HIS ENVIRONMENT is an introduction to using environmental study areas and interdisciplinary approaches to expand classrooms to include new dimensions of environmental awareness. This 56 page booklet, published by

the NEA's Association of Classroom Teachers, provides those interested in developing environmental programs with a brief look at the background of environmental study area programs, suggestions for selecting sites and planning programs, aids to identifying the educational possibilities of a site and preparing lessons related to them, a detailed discussion strand approach to environmental education, sample class activities based on the strand approach, and selected resources. An accompanying film strip is also available (details in the filmstrip listing of this guide). This 1970 publication (LC No. 79-136213) is available from Publication Sales Section, National Education Association, 1201 16th Street, N.W., Washington, D.C. 20036. Price $1.75 for single copy. Discount prices on quantity order available.

THE SCHOOLS AND THE ENVIRONMENT. This is the published report of a national seminar dealing with the title which was sponsored by the Institute for Development of Educational Activities, Inc. The seminar directed noted government representatives, educators and ecologists to develop guidelines that could be used in developing environmental studies for K through 12. In addition to guidelines and content for a K-12 program called "Strand IV - Environmental and Community Health" offered by the Niskayuna School District, Schenectady County, New York, the 32 page booklet also gives listings of audio-visual aids and books. Your $1.50 will be well spent for this resource by ordering from IDEA Mail Orders, P.O. Box 628, Far Hills Branch, Dayton, Ohio 45419.

Science-Oriented Resources

Although the following resources deal with scientific experiments the industrial arts teacher will find them useful in conducting cooperative, interdisciplinary activities with the science teacher. Much of the equipment needed to conduct the experiments could be designed and manufactured by industrial arts students.

AIR POLLUTION EXPERIMENTS FOR JUNIOR AND SENIOR HIGH SCHOOL SCIENCE CLASSES published by the Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh, Pa. 15231, 1969, 64 pages, $1.00/copy.

SCIENTIFIC EXPERIMENTS IN ENVIRONMENTAL POLLUTION by Elbert C. Weaver. Holt, Rinehard and Winston, Inc., New York 1968, 42 pages.

Environmental (Satirical) Humor

AMERICA THE BEAUTIFUL - Thirty one pages of the Nation's trashiest humor published by the Bureau of Solid Waste Management. Although the approach is humorous, the objective of public awareness is quite serious. This is a Public Health Service Publication (No. 2048) and is available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, price 35 cents.

NO LAUGHING MATTER - Well known cartoonists contribute their ecological humor to this collection of 60 satirical illustrations. Request Public Health Service Publication No. 1561 from U.S. Government Printing Office, price 70 cents.

Miscellaneous Materials

REBEL PACKRAT SOCIETY was established by the Plastic Research and Development Corporation for the purpose of getting citizen, especially youth, involved in an on going campaign to help control the litter problem in the United States. For 50 cents to cover postage and handling your student can join and will receive a packet including: pamphlet explaining REBEL PACKRAT SOCIETY, membership card, cloth Rebel Packrat Armpatch, decal, and auto bumper sticker. This kit is especially applicable at the junior high or middle school levels and could be used to preface numerous class activities dealing with solid waste pollution.

Having the student initiate their own membership on a volunteer basis is in itself an excellent activity. Provide them with the address and have them write the letter. From: Plastics Research and Development Corporation, 3601 Jenny Lind Road, Fort Smith, Arkansas 72901.

Filmstrips

CRISIS OF THE ENVIRONMENT - 5 full color filmstrips with L.P. records, printed texts and teaching manuals. From: The New York Times Book and Educational Division, Dept. M., New York, New York.

Environmental Magazines and Reports

WORLD ECOLOGY 2000 is a bi-weekly newsletter written in concise composed of interpretive reporting of the government-industry-academic involvement in science and technology. The staff directs its writing to executives, scientists, engineers or public officials who are concerned with environment and environmental decisions by distilling, evaluating and reporting the ecological events as they occur internationally.

This is an excellent resource for the ecology-minded school district to consider for central dissemination but perhaps too expensive for the individual teacher's budget. They are good applications and purchase justifications for interdisciplinary use with a school. ($125/yr. from Nautilus Press, Inc., 1056 National Press Building, Washington, D.C. 20004.

ENVIRONMENT MAGAZINE (formerly SCIENTIST AND CITIZEN), is published monthly by the Committee for Environmental Information, a non-profit St. Louis corporation, and includes information about the effects of technology on the environment and about the peaceful and military uses of nuclear energy. The editorial staff of ENVIRONMENT MAGAZINE is flanked by a distinguished Science Advisory Board and the Sceintific Division of the Committee for Environmental Information. The material in ENVIRONMENT is accurate and presented in a factual unbiased manner.

ENVIRONMENT is recommended for the industrial arts teacher since it is technology-oriented and also moderately priced. $8.50/year from Circulation Department, ENVIRONMENT, Post Office Box 755, Bridgeton, Missouri 63044.

DESIGN & ENVIRONMENT an interprofessional magazine for Architects, Engineers, City Planners, Landscape architects and designers that is published quarterly. There are excellent possibilities for the industrial arts teacher desiring to broaden his understanding of the critical role of industrial design in product development and services as part of the overall environment.

Subscription rate $11/yr. from RC Publications, Inc., 19 W. 44th Street, New York, New York.

Other Environmental Publications

AIR & WATER NEWS - This is McGraw Hills weekly report on environmental pollution: the law, the markets, and the technology. $145/yr. from McGraw-Hill, Inc., 330 West 42nd Street, New York, New York 10036.

SOLID WASTE REPORT - This publication details industrial programs in resource recovery, recycling, collection, and disposal. $48/yr. from Business Publishers, Inc., P.O. Box 1067, Blair Station, Silver Spring, Md. 20910.

ENVIRONMENTAL HEALTH LETTER - published twice a month from Gordon W. Fishhein, Publisher, 1097 National Press Building, Washington, D.C. 20004, $60/yr.

Although some of the above listed magazines and reports may be too expensive for the industrial arts teacher subscription, sample copies could be received upon request and would be helpful in gaining a general perspective of the industrial applications of science and technology in contracting process pollution.

Environmental Films

"WASTE MATERIALS: A NATIONAL RESOURCE"
New from NAM's industry on parade television series. Copies will be made available to companies and groups who wish to show it. The film is sponsored equally by The Aluminum Association, The American Iron & Steel Institute, The American Paper Industry, The Carbonated Beverage Controler Manufacturers Association, The Glass Container Manufacturers Institute and The Society of the Plastics Industries.
Booking will be arranged free of charge through National Association of Manufacturers, Publications, 277 Park Avenue, New York, New York 10017.

THE GIFTS
This new documentary describes America's natural legacy of clean water, pure air, and virgin land -- now threatened by pollution. It is narrated by Lorne Greene, with an original score by Skitch Henderson.
Available from Modern Talking Picture Service Library, 2323 New Hyde Park Road, New Hyde Park, New York 11040. Prints also available from other sources.

Rental requests should be ordered by Title and Order Number from:

National Medical Audiovisual Center (Annex)
Station K
Atlanta, Georgia 30323

DON'T LEAVE IT ALL TO THE EXPERTS (No. M-1739)
This film dealing with public concern and air pollution explains how the provisions of the Clean Air Act affect the citizen. The mechanisms for citizen expression are explored.
Produced by National Air Pollution Control Administration (16 mm - color - time: 16 minutes).

THE POISONED AIR (No. M-1418-X)
This CBS documentary spans the country and world with a series of air pollution disasters. Representatives from the Motor Vehicle Industry explain Detroit's position with regard to air pollution from cars, trucks and buses. St. Louis' and Pittsburgh's fight for clean air and California's attack on smog are also included.
Produced by CBS-TV (16 mm - 50 minutes - color - optical sound).

IT'S THE ONLY AIR WE'VE GOT (No. M-H31-X)
This film tells the story of Pittsburgh's continuing battle against air pollution. The film demonstrates the economic and aesthetic effects of dirty air and stresses the threat to health. The documentary presents the view of industrialists, scientists, and local and State officials regarding present and future air pollution control needs.
Produced by WTAE-TV, Pittsburgh, (16 mm - color - optical sound 25 minutes).

For the catalog "FREE FILMS ON AIR POLLUTION" request from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price 15 cents.

A DAY AT THE DUMP (No. M-1600-X)
Tells the story of Washington, D.C.'s open, burning Kenilworth Dump, but its message applies to open dumps throughout the nation. Health and safety hazards and the depressing effects on surrounding neighborhoods are cited. Plans for conversion to sanitary landfill are described.
(16 mm - color - sound - 15 minutes).

THE THIRD POLLUTION (No. AM-1404)

Dramatizes the nation's $4.5 billion-a-year problem of managing its solid wastes. This film describes the alternatives to burning refuse which contaminates the air and dumping which pollutes the ground water supply. The economical and technical problems of collection and solid waste disposal are given.

(16 mm - sound - color - 23 minutes).

THE STUFF WE THROW AWAY (No. M-2048-X)

Describes the massive problem of collecting and disposing of America's solid wastes and illustrates a variety of new and improved techniques that are being investigated and demonstrated under provisions of the Solid Waste Disposal Act.

(16 mm - sound - color - 22 minutes).

WHAT'S NEW IN SOLID WASTE MANAGEMENT (No. M-2049-X)

Shows a variety of new and improved solid waste management techniques, featuring specially developed equipment in operation. This is a more comprehensive analysis of the demonstrations and investigations conducted under the provisions of the Solid Waste Disposal Act.

(16 mm - sound - color - 37 minutes).

National Education Association Filmstrips available from NEA Publications Sales Section, 1201 16th Street, N.W., Washington, D.C. 20036 (Prepaid).

ENVIRONMENTAL CRISIS: WHAT THE INDIVIDUAL CAN DO (No. 388-11902)

Gives specific solutions for getting rid of selected environmental problems in a straightforward manner. Students discussed the philosophy of ecology and present recommendations for political, business and consumer actions.

(17 minutes, 117 frames, color with 33 1/3 RPM record)

MAN AND HIS ENVIRONMENT: A NEW APPROACH TO ENVIRONMENTAL EDUCATION (No. 388-119000)

Orients teachers, parents, school board members, and the public to an interdisciplinary environmental learning curriculum based upon environmental study areas. It is based upon the recently published 56 page booklet, Man and His Environment: An Introduction to Using Environmental Study Areas. The environmental education suggested introduces the student to his total culture and natural environment through the environmental study areas and five unifying concepts-or "Strands": variety and similarities patterns, interaction and interdependence, continuity and change, and evolution and adaptation. Copy of booklet is included.

(14 minutes, 91 frames, color, with 33 1/3 RPM record).

Miscellaneous environmental slide series information and catalogue from:

Environmental Communications
62 Windward Avenue
Venice, California 90291

Environmental Communications is an interdisciplinary group whose interest is to improve man's physical and social environment. Their project centers around an analysis of man's urban conditions and are communicated through film, photography, and graphics.

Government Publications

All publications listed below are available at the prices indicated from The Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402:

A PRIMER ON WASTE WATER TREATMENT is a 25 page booklet by the FWQA that describes present methods of collecting and treating waste water and the processes being researched and developed for future treatment of municipal and industrial waste waters. Price 55 cents.

AMERICA'S DEPARTMENT OF NATURAL RESOURCES - This is the story of the United States Department of the Interior. The 47 page booklet describes the activities and scope of the Department of Interior. The bureaus of America's Department of Natural Resources are explained. Among these are the bureaus of Land Management, Mines, Oil and Gas, Coal Research, Power Agencies, Reclamation, Water Pollution Control Administration, and Office of Water Resources Research. Price 40 cents.

CLEAN WATER FOR THE 1970's is a status report of the Federal Water Quality Administration which describes the FWQA's past activities and future plans. In addition to reporting the organization and operation of the agency as a part of the Department of Interior, the status report includes: a general analysis of Water Pollution and the Environment, A Water Pollution Control Program for the 1970's Programs for Water Pollution Control including research and development planning, regulatory and assistance programs. 78 pages, price $1.50.

CONSERVATION YEARBOOK SERIES

Published by the United States Department of the Interior, this series of six conservation yearbooks, printed in 9" by 12" page size in vivid color are a must for your environmental library. The series format combines the annual reports and special reports to the nation published previously. (Yearbook 6)

RIVER OF LIFE - $2.00, No. 11.95:6
This is the Department of Interior's National Environmental Report on Water. It documents the Department's progress in the regulation, research, wise use and cleansing of water resources. (1970)

IT'S YOUR WORLD (Yearbook 5) $2.00, No. 11.95:5
The grassroots conservation story of determined people who have succeeded against great odds in improving our environment. It includes ideas that have worked to make the nation more livable. (1969)

MAN . . . AN ENDANGERED SPECIES? (Yearbook 4) $2.00, No. 11.95:4
Sounds an alarm over the increasing destruction of the human habitat. (1968)

THE THIRD WAVE (Yearbook 3) $2.00, No. 11.95:3
Analyzes the new ecological approach to conservation. It defines conservation and its problems and then identifies specific Department of Interior actions.
Special color essays are striking and informative. (1966)

THE POPULATION CHALLENGE (Yearbook 2) $2.00, No. 11.95:2
Examines the environmental stress created by population pressures. (1966)

QUEST FOR QUALITY (Yearbook 1) $1.00, No. 11.2:Q3
Describes the kind of natural world we seek to establish. (1965)

CONTROL TECHNIQUES FOR CARBON MONOXIDE, NITROGEN OXIDE, AND HYDROCARBON EMISSIONS FROM MOBILE SOURCES (National Air Pollution Control Administration Publication No. AP-66)

A 1970 Report by the National Air Pollution Control Techniques Advisory Committee which is one of a series of documents to be produced under a program of the 1967 amendments to the Clean Air Act to carry out the responsibility for developing and distributing control technology information. The document has application for advanced transportation teaching. Some of the topics included in the contents are: Types and Numbers of Mobile Sources;

Types of Emission Control Systems; Effects of Fuel Modification and Substitution; Possible Substitutes for Currently Used Motor Vehicle Engines; Vehicle Emissions Research and Development. Price $1.25.

DANGER IN THE AIR: SULFUR OXIDES AND PARTICULATES
National Air Pollution Control Administration
Publication No. 1 (40 cents)

This booklet is one of a projected series prepared to inform the public of the nature of the air pollution problem and of the methods which must be taken to control it. It presents quantitative data and objective reactions regarding the sources and results of sulfur oxides and particulates as the two major air pollutants.

ENVIRONMENTAL QUALITY - The First Annual Report of the Council on Environmental Quality. This 326 page report of the President's Council was transmitted to Congress in August, 1970 and together with the President's message to Congress represents the most comprehensive description of the Federal Government's role in environmental enforcement to come out of Washington. Consultants, specialists and technical writers have assisted the Committee in making a thorough analysis of various environmental problems and reporting this to the public. Price $1.75. More information regarding the work of the President's Council on Environmental Quality and the contents of its "First Annual Report" can be found on page of this instructional guide.

POLICIES FOR SOLID WASTE MANAGEMENT - A report prepared by the Ad Hoc Committee on Solid Waste Management of the Division of Engineering Committees on Pollution Abatement and Control for THE BUREAU OF SOLID WASTE MANAGEMENT. This report deals with the management of solid wastes. An action program is outlined based on problem definitions, a study of need, a study of consultants, and an analysis of engineering requirements and alternatives. Specific attention is directed to the urban-generated portion of solid wastes and its resulting urban problems, and to effects of related agricultural, industrial, and commercial activity. Price 50 cents.

SHOWDOWN is a 25 page booklet prepared by the Office of Public Information, Federal Water Pollution Control Administration that traces the role of the Federal Government in water pollution control since it began in 1948 to the continuing programs under the Department of Interior. Primarily an overview and good for the student or teacher desiring the information in an easy reading style with good supportive pictures. Price 65 cents.

THE ROLE OF PACKAGING IN SOLID WASTE MANAGEMENT 1966 to 1976 (No. 1855), $2.25 paper cover.
Bureau of Solid Waste Management, 1969, 205 p.

Presents the findings of a research effort to define the role of packaging in waste disposal. The report is divided into three parts:

Part I presents historical packaging material consumption data for the 1958-66 period. A forecast of packaging material consumption to 1976, and a discussion of the economic, technological, marketing trends and forces underlying the forecast.

Part II analyzes the disposability of packaging materials in 1966 and in 1976. The solid waste burden imposed by packaging in the two years is discussed, as well as collection problems engendered by packaging material resistance to disposal processing.

Part III is an exploratory analysis of the various mechanisms that might be employed for lessening the problems caused by packaging materials in waste disposal.

Of particular value in the appendices is a bibliography of packaging and solid waste readings. Over 500 listings from primary industrial publications and trade journals provides (e.g. Modern Packaging, Business Inc., Modern Wastes, Paper Trade Journal, Printer's Ink, Chemical & Engineering News) the most comprehensive resource selection on any particular aspect of solid waste this researcher has found.

THE SOURCES OF AIR POLLUTION AND THEIR CONTROL
U.S. Department of Health, Education, and Welfare
Public Health Service Publication NO. 1548

Published by the National Air Pollution Control Administration in 1968 and revised in 1969, this 15 page booklet identifies the principal air pollutants and their effects on the environment. The sources of these pollutants, i.e., motor vehicles, industry, power plants, space heating and refuse disposal are discussed. Price 40 cents.

TODAY AND TOMORROW IN AIR POLLUTION is a U.S. Department of Health, Education, and Welfare publication prepared by the Public Health Service in cooperation with the National Center for Air Pollution Control. Although a 1967 printing, this 28 page brochure presents a factual analysis of the growing problem of air pollution using numerous grafts and charts. Price 35 cents.

## Industrial Publications

A CONCERN FOR THE TOTAL ENVIRONMENT
Deere & Company
Moline, Illinois 61265
This three page folder gives a capsule view of the causes of pollution and the past and future concerns of Deere & Company as the producer of farm equipment, industrial units and consumer products.

AIR AND WATER CONSERVATION
Atlantic Richfield Company
717 Fifth Avenue
New York, New York 10022
Presents a good representation of the petroleum industry as ARCO's efforts to control air and water pollution are described. This booklet illustrates some of the varying operating and conservation practices that are exercised along with corrective measures used when spillage occurs. The publication sub-divides ARCO's work in the areas of: Exploration and Production, Manufacturing, Marketing, Transportation, Research and Conservation. (33 pages)

AN IMPROVED ENVIRONMENT: 1971 PROGRESS REPORT of the Jones & Laughlin Steel Corporation illustrates pollution abatement programs at various plants. Copies and additional information about J & L's environmental activities are available upon request from the Public Relations Department, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh, Pennsylvania 15230.

A PRIMER OF NOISE MEASUREMENT - This 34 page booklet will provide you with the basics about noise, hearing damage, and noise measurement. Although it is written around a specific sound-level meter and its use, the booklet is a good beginning for additional readings on noise pollution. Available free from General Radio Company, West Concord, Massachusetts.

COMMITMENT
General Foods Corporation
White Plains, New York

This is a special 1970 issue of the GF News devoted to reporting the efforts of General Foods to help solve a number of social problems. It is quite conclusive and comprehensive, providing a broad view of G.F.'s actions in the field of social responsibility.

CURRENT is a bi-monthly newsletter published by the Manufacturing Chemists Association. It presents news of developments in air and water pollution control through interviews with pollution control officials and government and industry leaders, reports of research and development efforts, and news of pollution control equipment being used by chemical and related plants. To be placed on the MCA mailing list write to Manufacturing Chemists Association, 1825 Connecticut Avenue, N.W., Washington, D.C. 20009.

ENVIRONMENTAL CONTROL AND THE CONSULTING ENGINEER
Ford, Bacon & Davis
Incorporated Engineers
Two Broadway
New York, New York 10004

Ford, Bacon & Davis offers basic engineering and consultant services to industry, finance, and government. This booklet explains the specific engineering services available in the areas of water and air pollution and waste disposal.

ENVIRONMENT, SPECIAL REPORT IN
Caterpillar World
Caterpillar Tractor Company
Peoria, Illinois

This special report illustrates a perspective on the problems of industrial and consumer pollution with coverage of Caterpillar's efforts in water quality control, air pollution abatement, internal plant environment, environmental management, and R & D efforts to control Caterpillar products pollution. (27 pages)

HARVEST, Jan/Feb 1966 Special Water Issue
Personnel Administration Department
Campbell Soup Company
Camden, New Jersey

Although not a recent publication, it presents some of the process engineering used by Campbell and on-going part of their corporate efforts to maintain water quality in the industrial community. (29 pages)

KEEP IT CLEAN is a 32 page publication that highlights Bethlehem Steel's pollution control program. A series of excellent photos and illustrations presents the operation of pollution abatement equipment used by the steel industry and shows the results using "before and after" photos. Available free from: Bethlehem Steel Corporation, Bethlehem, Pennsylvania 18016.

LITTER, SOLID WASTE AND ALUMINUM RECYCLING: QUESTIONS AND ANSWERS. This folder answers questions about the difference between litter and solid waste, the development of current solid waste problems, aluminum packaging and aluminum reclaiming and recycling. Classroom copies are available free from the Environmental Services Department, The Aluminum Association, 750 Third Ave., New York, New York 10017.

Also available from The Aluminum Association:

THE SOLID WASTE CRISIS: ONE ANSWER, another folder that describes aluminum recycling in more detail.

MUNICIPAL ENVIRONMENTAL CONTROL
Calgon Corporation, Subsidiary of Merck & Co., Inc.
Calgon Center
Pittsburgh, Pennsylvania 15230
This booklet describes the function of the Calgon Environmental Group which provides, on a contractural basis, essential services to industries and municipalities concerned with controlling water pollution. The services, analytical services, equipment, engineering, and chemicals. Calgon's systems approach and new polysorb process for sewage treatment are explained. (14 pages)

POISON IN OUR AIR - This 100 page booklet consists of reprints of presentations made by government and industry officials at the National Conference on Air Pollution sponsored in March, 1969, by the United Steel Workers of America in cooperation with the National Air Pollution Control Administration. The conference reports deals with The Clean Environment Concept, Goverament Regulations, Citizen Action for Effective Standards, and The Feasibility of Control (Technology & Economics). Request by title and pamphlet No. P.R. 178 from Publications Department, United Steel Workers of America, 1001 Connecticut Ave., N.W., Washington, D.C. 20036.

POLLUTION ABATEMENT
Frontier Magazine - Winter 1970
III Research Institute
10 West 35th Street
Chicago, Illinois 60616

III Research Institute is an independent contract research organization serving industry and government. The publication, Frontier, disseminates information on significant topics in the R & D field. This issue presents an unbiased account of technical and economically sound solutions to the problems of pollution that are being used or considered by industry. (30 pages)

U. S. STEEL NEWS, Jan/Feb 1969 from
United States Steel Corporation
600 Grant Street
Pittsburgh, Pennsylvania 15230

A reprint of the section titled "Air and Water Care": '69 describes some of the air and water quality equipment that U.S.S. has added to its plants.

Also available at the same address is a more comprehensive bulletin describing the detailed pollution control technologies being used at the Gary Sheet and Tin Works title: "Four Major Advances in Safeguarding Water Quality".

REYNOLDS ALUMINUM AND THE PEOPLE WHO MAKE IT WORK - 1970
Reynolds Metals Company
Richmond, Virginia 23213

Although this booklet devotes only a small section to the specific question of environmental quality, it provides a useful summary of Reynold's corporate structure, processes and products and some of the social aspects of the company.

SOLID WASTE MANAGEMENT: A LIST OF AVAILABLE LITERATURE - Published by the Environmental Protection Agency, this is a collection of information pertaining to solid-waste research, demonstration projects and other activities published by the Solid Waste Management Office in compliance with The Solid Waste Disposal Act, (PL 89-272). Single copies available from Publications Distribution Unit, Solid Waste Management Office, U.S. Environmental Protection Agency, 5555 Ridge Avenue, Cincinnati, Ohio,45213.

THE AUTOMOBILE & AIR POLLUTION

This is a comprehensive two part report of The Panel on Electrically Powered Vehicles which was appointed by the Secretary of Commerce in 1967 as a study group to appraise the problem of automotive transportation in relation to the problem of air pollution.

Part I is primarily an analysis and recommendation which includes as broad topics: Air Pollution: The Problems and the Risks; Technology and the Control of Automotive Air Pollution; The Role of Industry; The Role of Government.

Part II is a companion to the Panel Report and includes the reports of six subpanels established to study in depth selected aspects of the problems of automotive air pollution. It is more detailed and contains the technical data in support of the Panel's findings and recommendations contained in Part I.

The six subpanels provide the six divisions of the book which are Air Pollution; Current Automotive Systems; Energy Storage and Conversion Systems; The Automobile and the Economy; Automotive Energy Sources; and Transportation System Requirements. Excellent Bibliography.

Although not for sale by the Superintendent of Documents, single copies for school district use may be secured by addressing your request to Department of Commerce Publications, Washington, D.C. 20402 (1970 printing 0-372-263 and 0-372-264 no price given).

THE ENVIRONMENTAL DECADE AND THE HIGHWAY USER

This publication is a must for industrial arts instructor teaching transportation related courses or units. It presents an overview of executive and legislative action during 1970 at national and state levels in the areas of air pollution in relationship to motor vehicles and motor vehicle fuels, the preservation of aesthetic values and environmental protection in highway development and operations, disposal of junked vehicles, the highway litter problem and legislative developments to control noises as it relates to motor vehicles.

Comes available at 60 cents from Highway Users Federation for Safety and Mobility, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036. (31 pages) Quantity prices on request.

THE GRACE LOG, Spring/Summer 1970 - article entitled "The Scene Around Us"
The Grace Log
W. R. Grace & Company
7 Hanover Square
New York, New York 10005

W. R. Grace & Company is an international industrial concept with chemical, consumer products and petroleum interests and describes its progress in anti-pollution product lines and in corporate clean-up efforts. (24 pgs.)

THE PLASTICS INDUSTRY AND SOLID WASTE MANAGEMENT is an 11 page report by The Society of the Plastic Industry, Inc. which outlines the role of plastics in solid waste management. It discusses the ecological benefits of plastics, disposal systems and the SPI's solid waste activities. This position statement of the plastics industry is available upon request from The Society of Plastics Industries, Inc., 250 Park Avenue, New York, New York 10017.

TOWARD A BETTER ENVIRONMENT, 1970
E. I. DuPont de Nemours & Company, Inc.
Wilmington, Delaware 19898

DuPont describes its program and economic and human resource emphasis on environmental protection at selected plants. (28 pages)

Also available from DuPont:
COMPANY AND COMMUNITY: THE RESPONSIBILITY OF BUSINESS IN SOCIETY, 1967

Presents a balanced picture of the various social roles that industry plays in community life with emphasis on DuPont's efforts in external relations including pollution control, equal opportunity employment, training and retraining programs, and aid to education through research, honors awards. (33 pages)

TRANSPORTATION CRISIS
Caterpillar Tractor Company
Peoria, Illinois 61602

Calls attention to the serious nationwide transportation problem.

YOUR CAR AND CLEAN AIR
Automobile Manufacturers Association, Inc.
320 New Center Building
Detroit, Michigan 48202

A national report from the Automobile Manufacturers Association that discusses vehicle emissions as pollutants, present emission controls, research, and future goals

for emission standards. This is an excellent primer for power or transportation classes at the junior or senior high levels. Classroom copies are available on request to the above address. (16 pages)

Other Resources

DIRECTORY OF GOVERNMENTAL AIR POLLUTION AGENCIES, published by the Air Pollution Control Association in cooperation with the National Air Pollution Control Administration of the Environmental Protection Agency. This publication identifies, by state as well as federal levels, the numerous air pollution agencies and their directors and staff qualifications. This booklet is valuable in making the appropriate contacts in the teacher's respective state as well as presenting the organization and scope of agencies dealing with air pollution. Copyrighted in 1970, the Directory is available upon request from Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh, Pennsylvania 15213.

IMPROVE YOUR ENVIRONMENT: FIGHT POLLUTION WITH PICTURES. This is a new 8 1/2 x 11 book by Eastman Kodak Company which explains how to take and use pictures for environmental activities and campaigns. Using over 250 color and black-and-white environmental photographs made by students, youth organizations, conservation groups, women's clubs, garden clubs, governmental agencies, business, and industry. IMPROVE YOUR ENVIRONMENT documents all types of pollution problems and shows how photos can be used to promote conservation, beautification, and pollution-abatement programs.

This book is a must for the teacher who desires to produce his own visuals or direct his students towards good pictural taking in conjunction with environmental activities. IMPROVE YOUR ENVIRONMENT is available at photo-supply stores or can be ordered by title and code (AC-26) directly from Eastman Kodak Company, Department 454, 343 State Street, Rochester, New York 14650. Prices: Single copies - $1.00, 2-9 copies - $.75, more copies - $.50 each.

MAN'S IMPACT ON THE GLOBAL ENVIRONMENT - A report of the Study of Critical Environmental Problems (SCEP)including assessments and recommendations for action, sponsored by the Massachusetts Institute of Technology, The MIT Press, Cambridge, Massachusetts, 1970, 319 pages. (paper back)

This is a rather comprehensive report of the SCEP which originated at MIT and was conducted during the

entire month of July, 1970. Scientists, professionals and consultants drawn from seventeen universities, thirteen federal departments and agencies, three national laboratories, and eleven non-profit and industrial corporations concentrated on the global climatic and ecological effects of several special pollutants. The Report presents the scientific and technical judgments of the participants and the procedures and problems of focused research, monitoring environmental and action. MAN'S IMPACT ON THE GLOBAL ENVIRONMENT is recommended highly for your environmental library resources.

The following three publications are available from The American Iron and Steel Institute, 1000 16th Street, N.W., Washington, D.C. 20036.

ENVIRONMENTAL QUALITY BULLETIN for Steel Comapnies. This bulletin reports the latest environmental activities in the steel industry including pollution abatement equipment installations, methods and engineering innovations, community activities and news releases. Although it is distributed primarily to the steel industries, industrial arts teachers will be placed on the mailing list.

THE STEEL INDUSTRY TODAY is a comprehensive 38 page report by the Domestic Membership Companies of AISI to the Cabinet Committee on Economic Policy as requested by President Nixon. This May, 1971 release reports on steel technologies, steel productivity, eroding steel markets and revenues and increases in costs. Numerous charts and graphs profile the steel industry's operations.

IN QUEST OF CLEANER AIR AND WATER describes the steel industry's investments and programs in air and water pollution control. Some excellent color prints are used to present notable abatement activities.

COORS ALUMINUM RECYCLING PROGRAM. This well-organized packet describes the Adolph Coors Company Cash-for-Cans Program and provides information, in kit form, for identifying aluminum cans. Sample kits are available upon request from: Adolph Coors Public Relations Department, 1321 Bannock Street, Denver, Colorado 80204.

Resources for simulation and gaming

Environmental Games from URBAN SYSTEMS, INC.

DIRTY WATER - The Water Pollution Game meets the challenge of industrial wastes, nuclear power plants, and pollution from upstream in this stimulating fight for clear water. #1100

SMOG - The Air Pollution Game - A fascinating game that lets players battle business interests, public indifference and federal funding to bring back clean air. #1200

ECOLOGY - A Game of Man and Nature. Build a better world by leading a population through the history of conflict between man's inventive genius and his environment. #1300

POPULATION - A Game of Man and Society. An intriguing game that lets you face and solve -- the crisis of over population in a rapidly developing country. #1400

Each of the above games retails for $10.00. For more information and school price lists write Urban Systems, Inc., 1033 Massachusetts Avenue, Cambridge, Massachusetts 02138.

# APPENDIX I

## ENVIRONMENTAL GLOSSARY

# A SELECTED ENVIRONMENTAL GLOSSARY

ABSORPTION: Process by which one substance is dissolved by and distributed throughout the body of a second material, as a soluble gas, such as ammonia, is collected in water droplets.

ACCELERATOR: In nuclear physics, a device for speeding up charged subatomic particles to high enough energies to smash the nuclei of target atoms. Often called an atom-smasher. Accelerators are used routinely to produce radioisotopes.

ACTIVATED CARBON: A highly adsorbent form of carbon, used to collect many gaseous pollutants. Used both for measurement and control.

ACTIVATED WATER: A transient, chemically very reactive state created in water by absorbed ionizing radiation. Water used as a coolant in a nuclear reactor becomes so activated.

ADSORBENT: In addition to the adjectival meaning, the term describes any of several substances that collect gaseous pollutants. Used both for measurement and control.

ADSORPTION: Process by which gases or vapors are collected on the surface of a solid phase, by reason of the attraction between that surface and the absorbed material. Collection of organic vapors on activated charcoal is an example.

AERATION: Creating intimate contact between air and a liquid by: spraying the liquid in the air; bubling air through the liquid, or by agitation of the liquid to promote surface absorption of air.

AEROSOL: Particle of solid or liquid matter that can remain suspended in the air because of its small size. Particulates under 1 micron in diameter are generally called aerosols.

AFTERBURNER: A device that includes an auxiliary fuel burner and combustion chamber to get rid of combustible air contaminants.

AIR: So-called pure air is a mixture of gases containing about 78% nitrogen; 21% oxygen; less than 1% of carbon dioxide, argon, and other inert gases; and varying amounts of water vapor.

AIR CONTAMINANT: Any "foreign" material in the air, that is, material other than oxygen, nitrogen, the noble gases, water vapor, and carbon dioxide. Air contaminants include, but are not limited to the following examples:

AIR MONITORING: The continuous sampling for and measuring of pollutants present in the atmosphere.

AIR POLLUTION: Man-made contamination of the atmosphere, beyond that which is natural and excluding the narrowly occupational, as the contaminated air that miners or asbestos workers breathe.

AIR QUALITY CONTROL REGION: As the federal government uses the term, an area where two or more communities--either in the same or different states--share a common air pollution problem. Designated by the Secretary of Health, Education, and Welfare, these regions are required to set and enforce consistent air quality standards.

AIR QUALITY CRITERIA: As the federal government uses the term, the varying amounts of pollution and lengths of exposure at which specific adverse effects to health and welfare take place.

AIR QUALITY STANDARD: As the federal government uses the term, the prescribed level of a pollutant in the outside air that cannot legally be exceeded during a specified time in a specified geographical area.

AIRSHED: A term, now little used, denoting a geographical area the whole of which, because of topography, meteorology, and climate, shares the same air. See atmospheric area.

AIRWAY RESISTANCE: The narrowing of the air passages of the respiratory system in response to the presence of irritating substances.

AMBIENT AIR QUALITY: Definition of the outdoor atmosphere as it exists around people, plants and structures--as contrasted to that in immediate proximity to emission sources.

AMBIENT AIR QUALITY CRITERIA: A scientific relationship between particular concentrations and durations of specific air contaminants, and the effects they produce on persons, animals, plants or materials. "Criteria" in this sense has a connotation distinct from "standard." Although the dictionary lists the two as synonymous, care must be exercised not to confuse them in any consideration of air pollution control.

AMBIENT AIR QUALITY STANDARDS: Legal statements of ambient air quality that are subject to enforcement by law. Standard may specify maximum peak concentration of contaminant allowable, maximum average concentration and/or frequency and duration of excursions above a given concentration. Criteria inform what effects can be avoided through adoption of a given standard.

ANODE: A positive electrode.

ASSIMILATIVE CAPACITY: Capacity of a water body to receive, dilute, and carry away wastes without harming water quality. In the case of organic matter, also includes the capacity for natural biological oxidation, which may be expressed in pounds of BOD per day at a specific river flow rate and temperature.

ATMOSPHERE: Outdoor air; more specifically, the troposphere.

ATMOSPHERIC AREA: As the federal government uses the term, a segment of the continental United States in which climate meterology, and topography--all of which influence the capacity of the air to dilute and disperse pollutants--are essentially similar.

ATTRITION: Wearing or grinding down by friction. One of the 3 basic contributing processes of air pollution, the others being vaporization and combustion.

BETA RAY: A stream of negatively charged electrons ejected from the nucleus of an atom; more penetrating than an alpha ray but producing less ionization. Often written B-ray.

BIOCHEMICAL OXYGEN DEMAND (BOD): Quantity of oxygen used in the biological oxidation of organic matter, in a specified time and at a specified temperature, determined by its availability to serve as food for the microorganisms. BOD can be related to the oxygen resources of a stream. For example, after dilution and mixing in a stream, one part of BOD will consume one part of oxygen in the stream.

BIOLOGICAL OXIDATION: Process by which bacteria and other microorganisms feed on complex organic materials and decompose them. Self-purification of waterways, as well as activated sludge and trickling filter waste treatment processes, depend on this principle. It is also called Biochemical Oxidation.

BIOSPHERE: All living things together with their environment.

BLOOM: A visible concentrated growth of algae and/or other aquatic plants.

CARBON MONOXIDE: A colorless, odorless, very toxic gas produced by any process that involves the incomplete combustion of carbon-containing substances. One of the major air pollutants, it is primarily emitted through the exhaust of gasoline-powered vehicles.

CARBURETOR: A device for supplying certain internal-combustion engines with a mixture of vaporized fuel and air.

CATHODE: A negative electrode.

CATALYSIS: The facilitation of a chemical reaction induced by a material--called the catalyst--that remains unchanged in the process.

CENTRIFUGAL COLLECTOR: Any of several mechanical systems using centrifugal force to remove aerosols from a gas stream.

CHEMICAL ENERGY: The energy contained in the chemical bond between atoms; it can be released into the environment by a chemical reaction; e.g., combustion.

CHEMICAL OXYGEN DEMAND (COD): Laboratory measurement of the amount of oxygen consumed under specific conditions in the oxidation of organic material by a strong chemical oxidant which decomposes both biodegradable (measured by Biochemical Oxygen Demand) and non-biodegradable organic matter.

CLARIFIER: A tank or other vessel to accomplish removal of settleable solids; e.g., as in an activated sludge process. Settling basin serves similar purposes.

COH: Abbreviation for coefficient of haze, unit of measurement of visibility interference.

COMBUSTION: The production of heat and light energy through a chemical process -- usually oxidation. One of the 3 basic contributing processes of air pollution, the others being attrition and vaporization.

COMMUNITY AIR: The outside air shared by a community, rather than the perhaps particularly polluted air in the immediate vicinity of a factory.

CONDUCTION: The transfer of heat by physical contact between substances.

CONTAMINATION: The impairment of water quality to the extent that a health hazard is created.

CONVECTION: The transfer of heat through a liquid or gas by the actual movement of the molecules.

CYCLONE COLLECTOR: A kind of centrifugal collector.

DEGRADABLE WASTES: Substances which are changed in form and/or reduced in quantity by the biological, chemical, and physical phenomena characteristic of natural waters.

DIESEL ENGINE: A type of internal-combustion engine that uses a fuel injector and produces combustion temperatures by compression.

DISSOLVED OXYGEN (DO): Extent to which oxygen occurs dissolved in water or wastewater. It is usually expressed as concentration, in parts per million, or per cent of saturation.

DISTILLATION: The removal of impurities from liquids by heating the liquids to the boiling point and then condensing the vapors.

DUST: Solid particles small enough to become airborne, formed by attrition of larger particles.

ECOLOGY: The totality or pattern of the interrelationship of organisms and their environment, and the science that is concerned with that interrelationship.

ECONOMIC POISONS: Those chemicals used as insecticides, rodenticides, fungicides, herbicides, nematocides (a nematode is a class of parasitic worm), or defoliants.

ECOSPHERE: The layer of earth and troposphere inhabited by or suitable for the existence of living organisms.

EFFLUENT: In this context refers to a flow of wastewater to its receptor; the wastewater may or may not have been subjected to waste treatment, and the receptor may be a river, municipal sewer, or the like.

EFFLUENT STANDARDS: Defined limits of waste discharge, e.g., in terms of volume, content of contaminants, temperature, and the like.

ELECTRODE: A conductor used to establish electrical contact with a non-metallic part of a circuit, such as an electrolyte. There are two electrodes in such a circuit, the anode, with a positive charge, and the cathode, with a negative one. See electrolysis.

ELECTROLYSIS: The production of chemical changes by means of an electric current passing through an electrolyte.

ELECTROLYTE: A non-metallic substance which will conduct an electric current by the movement of ions when dissolved in certain solvents or when fused by heat; common salt is an example.

ELECTROMAGNETIC WAVES: Waves of radiant energy, commonly classified, according to wave frequency and length, as Hertzian (radio) infrared, visible (light), ultraviolet, X-ray, and gamma ray; and, by extension, particle emissions, such as alpha and beta radiation, or rays of mixed or unknown type, as cosmic radiation.

ELECTROSTATIC PRECIPITATOR: A device which collects particulate matter by passing the air stream through a strong electric field and negatively charging the suspended particles which are then drawn to a positive collecting electrode. Precipitator can remove 99.9 percent of all particulates.

EMISSION INVENTORY: A list of primary air pollutants emitted into a given community's atmosphere, in amounts (commonly tons) per day, by type of source. The emission inventory is basic to the establishment of emission standards. Also see emission factor.

EMISSION STANDARDS: Legally enforceable limits on the quantities and/or kinds of air contaminants that may be emitted into the atmosphere. For example: Limits expressed in maximum concentration of contaminant in the discharged gases; maximum weight of such discharge, either as an hourly rate or in relation to the quantity of material being processed; or in terms of the appearance of the discharge.

ENVIRONMENT: The aggregate of all the external conditions and influences affecting the life, development, and ultimately the survival of an organism.

EPIDEMIOLOGY: The study of diseases as they affect populations rather than individuals, including the distribution and incidence of a disease; mortality and morbidity rates; and the relationship of climate, age, sex, race, and other factors.

EUTROPHICATION: Over-enrichment of a quiescent water body by water nutrients, tending to produce excessive plant growth. Commonly associated with accelerated "aging" of lakes, namely progressive change in the indigenous plant and animal life supported therein.

FILTER COLLECTOR: A mechanical filtration system for removing particulate matter from a gas stream, for measurement, analysis, or control. Also called bag collector. Filters are designed in a variety of sizes and materials for specific purposes.

FLARE: A fire produced by a pilot flame at a stack outlet, used in many heat treating operations and petroleum industry processes to burn combustible waste gases.

FLUORIDES: Gaseous or solid compounds containing flourine, emitted into the air from a number of industrial processes; fluorides are a major cause of vegetation and--indirectly--livestock damage.

FLY ASH: The particulate impurities resulting from the burning of coal and other material, which are exhausted into the air from stacks.

FOG: The condensation of water vapor in the air. Also see smog.

FOSSIL FUELS: Coal, oil, and natural gas; so-called because they are the remains of ancient plant and animal life.

FUEL CELL: A device for converting chemical energy into electrical energy.

FUME: Solid particles under 1 micron in diameter, formed as vapors condense or as chemical reactions take place.

FURNACE: A combustion chamber; an enclosed structure in which heat is produced.

GASES: Materials that can be condensed to liquids only by pressure, or at temperatures below ambient (such as oxygen, methane, hydrogen).

GENERATOR: A device that changes mechanical energy into electrical energy.

GREENHOUSE EFFECT: The phenomenon in which the sun's energy, in the form of light waves, passes through the air and is absorbed by the earth, which then reradiates the energy as heat waves that the air is able to absorb. The air thus behaves like glass in a greenhouse, allowing the passage of light but not of heat.

HALF-LIFE: The period of time required for 1/2 of the atoms of a given radioactive substance to decay.

HEAT EXCHANGER: A device for transferring heat energy in a nuclear reactor without contaminating the final energy carrying substance with radioactivity.

HEAT ISLAND EFFECT: The phenomenon of air circulation peculiar to cities, in which warm air builds up in the center, rises, spreads out over the town, and as it cools, sinks at the edges; while cooler air from the outskirts flows in toward the city center to repeat the flow-pattern. In this way, a self-contained circulation system is put in motion that cen be broken only by relatively strong winds.

HYDROCARBON: Any of a vast family of compounds containing carbon and hydrogen in various combinations; found especially in fossil fuels. Some of the hydrocarbon carbons are major air pollutants: they may be carcinogenic or active participants in the photochemical process.

INCINERATION: The burning of household or industrial waste.

INERT GAS: Also called noble or rare gas; one that does not react with other substances under ordinary conditions.

INERTIAL SEPARATORS: Air pollution control equipment that uses the principle of inertia to remove particulate matter from a stream of air or gas.

INVERSION: The phenomenon of a layer of cool air trapped by a layer of warmer air above it so that the bottom layer cannot rise. A special problem in polluted areas because the contaminating substances cannot be dispersed.

LAGOON: Scientifically construcoted pond in which sunlight and oxygen support the action of microorganisms in decomposing organic wastes by biological oxidation.

LOW FLOW AUGMENTATION: Controlled discharge of water from an inpoundment or reservoir for dilution of waste during periods of low stream flow.

MECHANICAL TURBULENCE: The erratic movement of air influenced by local obstructions.

MIST: Liquid particles up to 100 microns in diameter.

MIXING DEPTH: The expanse in which air rises from the earth and mixes with the air above it until it meets air equal or warmer in temperature.

NITROGEN OXIDES: Gases formed in great part from atmospheric nitrogen and oxygen when combustion takes place under conditions of high temperature and high pressure; e.g., in internal-combustion engines; considered major air pollutants.

NUCLEAR ENERGY: The force released by nuclear decay; radioactivity.

ORGANIC: Of, relating to, or derived from living organisms; in chemistry, a carbon-containing compound.

OXIDANT: The capacity of certain oxygen-containing substances to react chemically in the air to form new substances. Also any of the substances that make oxygen available for such a chemical reaction.

OXIDES OF NITROGEN: Compounds formed by the fixation of nitrogen at high temperatures, as in furnaces and internal combustion engines. Primary product is nitric oxide (NO), which slowly oxidizes in air, but much more rapidly in the presence of sunlight and organic vapors, to nitrogen dioxide ($NO_2$). Other nitrogen oxides may have brief existence as intermediates in the atmospheric reactions involved.

OXIDES OF SULFUR: Products of the oxidation of sulfur; they include both sulfur dioxide ($SO_2$) and sulfur trioxide ($SO_3$), and the acids formed by their combination with water. Of these, sulfuric acid ($H_2SO_4$), is of principal interest.

OZONE: A form of oxygen ($O_3$) produced in the reactions of photochemical smog and in electrical discharges. A powerful oxidizing agent and toxic to both plants and animals at relatively low concentrations.

PAN: Peroxyacetylnitrate--one of the family of peroxyacly-nitrates--reactive compounds formed in photochemical smog, highly toxic to many species of plants, and to which, at least in part, the eye-irritating properties of photochemical smog have been ascribed.

PHOTOCHEMICAL PROCESS: The chemical changes brought about by the radiant energy of the sun acting upon various polluting substances. The products are known as photochemical smog.

PPM: Parts per million; the number of parts of a given pollutant in a million parts of air.

PRECIPITATORS: Any of a number of devices using mechanical, electrical, or chemical means to collect particulates. Used for measurement, analysis, or control.

PRIMARY TREATMENT: First stage of waste treatment, usually by sedimentation, removing a high percentage of suspended matter but little or no colloidal or dissolved matter.

RINGELMANN CHART: Actually a series of charts, numbered from 0 to 5, that simulate various smoke densites, by presenting different percentages of black. A Ringelmann No. 1 is equivalent to 20 per cent black; a Ringelmann No. 5, to 100%. They are used for measuring the opacity of smoke arising from stacks and other sources, by matching with the actual effluent the various numbers, or densities, indicated by the charts. Ringelmann numbers are sometimes used in setting emission standards.

SCRUBBER: A device that uses a liquid spray to remove aerosol and gaseous pollutants from an air stream. The gases are removed either by absorption or chemical reaction. Solid and liquid particulates are removed through contact with the spray. Scrubbers are used for both the measurement and control of pollution.

SECONDARY TREATMENT: Second stage of waste treatment, usually connoting treatment by biological oxidation.

SEDIMENT: Soil and mineral solids of small particle size conveyed in water.

SELF-PURIFICATION: The process by which a stream becomes pure after being polluted. This occurs by oxygen-using bacteria decomposing organic matter which may enter a stream, and by the natural replenishment of oxygen from the atmosphere.

SETTLEABLE SOLIDS: Suspended solids which will settle out in a reasonable period of quiescence. Such period is commonly, though arbitrarily, taken as two hours. Also called settling solids.

SMOG: The irritating haze resulting from the sun's effect on certain pollutants in the air, notably those from automobile exhaust; see photochemical process. Also a mixture of fog and smoke.

SMOKE: Solid and/or liquid particles formed by the incomplete combustion of fuels, and discharged suspended in the gaseous combustion products.

SOOT: Solid particles containing carbon formed by the incomplete combustion of carbonaceous fuels.

SORPTION: A term including both adsorption and absorption. Sorption is basic to many processes used to measure, analyze, and remove both gaseous and particulate pollutants.

STACK: A smokestack; a vertical pipe or flue designed to exhaust gases and any particulate matter suspended therein.

SULPHUR OXIDES: Pungent, colorless gases formed primarily by the combustion of fossil fuels; considered major air pollutants; sulfur oxides may damage the respiratory tract as well as vegetation.

SUSPENDED SOLIDS: Solids that either float on the surface or remain suspended in liquids; removable by filtering.

VAPOR: Gaseous material which results from dilution with fixed gases, but which, if pure, would occur as a solid or liquid at the ambient temperature (such as water vapor).

VAPORIZATION: The change of a substance from the liquid to the gaseous state. One of the 3 basic contributing processes of air pollution, the others being attrition and combustion.

WATER POLLUTION: Presence of one or more contaminants in such degree as to be detrimental to the intended use of the water.

WATER QUALITY CRITERIA: Scientific data relating the concentration of one or more substances in water to the effects produced therefrom.

WATER QUALITY STANDARDS: Usually refers to permissible limits of certain water contaminants as defined in laws or regulations, compliance with which is required. Normally established on the basis of the quality requirements for selected beneficial water uses.

## APPENDIX 2

NATIONAL ASSOCIATION OF MANUFACTURERS

1971

ENVIRONMENTAL QUALITY COMMITTEE

NATIONAL ASSOCIATION OF MANUFACTURERS

1971

ENVIRONMENTAL QUALITY COMMITTEE

CHAIRMAN: M.P. Venema
Chairman of the Board &
Chief Executive Officer
Universal Oil Products Company
Des Plaines, Illinois 60016

VICE CHAIRMAN: Donald R. Talbot, Director
Martin Marietta Corporation
Friendship International Airport
Maryland 21240

NATIONAL INDUSTRIAL COUNCIL LIASON ADVISERS

Representing State Group

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1212 Des Moines Building
Des Moines, Iowa 50309

Bob Lamb
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Associated Industries of Arkansas, Inc.
911 Wallace Building
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Vice-President
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475 Park Avenue So. at 32nd Street
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Russell E. MacCleery
Administrative Vice-President
Automobile Manufacturers Association
320 New Center Building
Detroit, Michigan 48202

CHEMICAL INDUSTRIES

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Water Technologies Division
225 North Grand Avenue
Waukesha, Wisconsin 53186

Diversey Chemical Company
Wilford H. Ross
Director of Research and
Development
212 W. Monroe Street
Chicago, Illinois 60606

Dow Chemical Company
Charles L. Sercu
Assistant Manager
Environmental Control
Midland, Michigan 48640

Hooker Chemical Corporation
Jerome Wilkenfeld, Director
Environmental Health
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1515 Summer Street
Stamford, Connecticut 06905

Stauffer Chemical Company
Dr. Myron V. Anthony, Director
Environmental Control
1612 K Street, N.W.
Washington, D.C. 20006

ELECTRICAL AND NUCLEAR POWER INDUSTRIES

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Peoria, Illinois 61602

Central Power and Light Company
Fred C. Repper
Director of Public Affairs
120 N. Chaparral
(P.O. Box 2121)
Corpus Christi, Texas 78403

Cincinnati Gas & Electric Company
Edward C. Pandorf
Senior Engineer
Research & Special Projects
P.O. Box 960
Cincinnati, Ohio 45201

Public Service Electric and Gas Company
Erwin C. Wackenhuth
Chemical Plant Engineer
80 Park Place
Newark, New Jersey 07101

Texas Power & Light Company
Robert T. Person
Director of Ecology Management
1511 Bryan
Dallas, Texas 75222

Transcontinental Gas Pipe Line
Corporation
C. H. Mullendore, Jr.
Vice-President
Marketing
744 Broad Street
Newark, New Jersey 07102

Western Electric Company, Inc.
Joseph F. Ruth
General Manager
Plant Design and Construction
222 Broadway
New York, New York 10038

ENVIRONMENTAL ENGINEERING SERVICES

Calgon Corporation
Subsidiary of Merck & Co., Inc.
Edgar G. Paulson
Technical Consultant
Environmental Group
Box 1346, Calgon Center
Pittsburgh, Pennsylvania 15230

Ford, Bacon & Davis, Inc.
William D. Bruce
Senior Vice-President
2 Broadway
New York, New York 10004

Lockwood Greene Engineers, Inc.
Herbert A. Schlesinger
Manager
Pollution Control Department
230 Park Avenue
New York, New York 10017

Zurn Industries, Inc.
Bernard S. MacCabe
Group Vice-President
1422 East Avenue
Erie, Pennsylvania 16503

FOOD INDUSTRIES

Campbell Soup Company
Louis C. Gilde, Director
Environmental Engineering
375 Memorial Avenue
Camden, New Jersey 08101

Coca-Cola USA
Harry E. Teasley
Product Manager, Packaging
P.O. Drawer 1734
Atlanta, Georgia 30301

General Foods Corporation
David E. James
Director of Quality Assurance
250 North Street
White Plains, New York 10602

General Mills, Inc.
Dr. James W. Haun
Vice President &
Director of Engineering
9000 Plymouth Avenue, N.
Minneapolis, Minnesota 55427

Great Western Sugar Company
Lloyd T. Jensen
Executive Vice-President &
General Manager
P.O. Box 5308
Terminal Annex
Denver, Colorado 80217

Grain Processing Corporation
Myron O. Brower
Vice-President, Operations
1600 Oregon Street
Muscatine, Iowa 52761

Western Alfalfa Corporation
Carmelo A. Vinci
Vice-President
4800 Main Street Suite 300
Kansas City, Missouri 64112

GENERAL MANUFACTURING INDUSTRIES

Carborundum Company
John F. Claydon
Senior Vice-President
Buffalo Avenue
Niagara Falls, New York 14302

Cessna Aircraft Company
E. Duane Stone
Plant Engineer
P.O. Box 1877
Wichita, Kansas 67201

GENERAL MANUFACTURING INDUSTRIES con'd

E. I. du Pont de Nemours & Company
Charles E. Welch, Director
Governmental Affairs Division
Legal Department
1007 Market Street
Wilmington, Delaware 19898

General Electric Company
Dr. J. Steven Anderson, Consultant
Environmental Pollution Control
1 River Road
Schenectady, New York 12305

Metal Forge Company
William A. Carlile, Jr.
President
50 West Broad Street
P.O. Box 2139
Columbus, Ohio 43216

Owens-Corning Fiberglas Corporation
Samuel H. Thomas
Director of Environmental Control
Fiberglas Tower
Toledo, Ohio 43601

Union Carbide Corporation
Joseph S. Whitaker
Coordinator Environmental Health
270 Park Avenue
New York, New York 10017

Wean Industries, Inc.
Richard J. Lackner
Director of Marketing
Environmental Control Division
(A Wean United Company)
347 North Park Avenue
Warren, Ohio 44482

W.R. Grace & Company
Jack J. Combes
Environmental Control Coordinator
7 Hanover Square
New York, New York 10005

Youngstown Sheet & Tube Company
William J. Harnisch
Legislative Counsel
P.O. Box 900
Youngstown, Ohio 44501

3M Company
Joseph T. Ling, Manager
Environmental and Civil
Engineering
900 Bush Avenue
St. Paul, Minnesota 55101

HEAVY EQUIPMENT INDUSTRIES

Caterpillar Tractor Company
W. W. Dodge, Manager
Environmental Control G.O.
100 N.E. Adams Street
Peoria, Illinois 61602

Deere & Company
Clarence H. Savery
Pollution Control Engineer
John Deere Road
Moline, Illinois 61625

MINING AND NON-FERROUS METALS INDUSTRIES

American Smelting and Refining Company
Donald E. Rouillard
Assistant to Vice-President
Industrial Relations and Personnel
120 Broadway
New York, New York 10005

National Lead Company
William L. Mann, Manager
Environmental Health Department
111 Broadway
New York, New York 10006

MINING AND NON-FERROUS METALS INDUSTRIES cont'd

Reynolds Metals Company
Richard H. Mansur, Director
Environmental Control
6603 W. Broad Street
Richmond, Virginia 23230

Titanium Metals Corporation of America
Eugene V. Francy
Assistant Plant Manager
P.O. Box 2128
Henderson, Nevada 89015

PAPER INDUSTRIES

Bergstrom Paper Company
Franklin Moore, Jr., Secretary
Bergstrom Road
Neenah, Wisconsin 54956

St. Regis Paper Company
James E. Kussmann
Assistant Vice-President & Director
Public Relations
150 East 42nd Street
New York, New York 10017

PETROLEUM INDUSTRIES

Ashland Oil & Refining Company
Frederick L. Paul
Plant Manager
Ashland Oil & Refining Company
400 Doremus Avenue
Newark, New Jersey 07105

Chevron Research Company
Robert S. Cramer
Senior Staff Engineer
576 Standard Avenue
Richmond, California 94802

Cities Service Company
Charles P. Goforth
Coordinator of Environmental Affairs
70 Pine Street
New York, New York 10005

Humble Oil & Refining Company
H.H. Meredith, Coordinator
Air & Water Conservation
P.O. Box 2180
Houston, Texas 77001

Standard Oil Company
B.N. Marsh, Vice-President
Midland Building
Cleveland, Ohio 45115

Mobil Oil Corporation
Edward W. McMahon
Government Relations Advisor
150 E. 42nd Street
New York, New York 10017

Texaco, Inc.
Charles E. Moser
Assistant to Vice-President
Deputy Air and Water Conservation
Coordinator
P.O. Box 509
Beacon, New York 12508

STEEL INDUSTRIES

Armco Steel Corporation
W.E. Harrison, Manager
Engineering Services
815 Connecticut Avenue, N.W.
Washington, D.C. 20006

Bethlehem Steel Corporation
J.R. Sweeney
Assistant Manager
Washington Office
1000 16th Street, N.W.
Washington, D.C. 20036

Republic Steel Corporation
Harold C. Lumb
Vice-President
Corporate Relations and
Public Affairs
P.O. Box 6778
Cleveland, Ohio 44101

Republic Steel Research Center
Louis F. Firkel, Supervisor
Water Management
6801 Brecksville Road
Cleveland, Ohio 44131

United States Steel Corporation
Joseph H. McGinty, Manager
Environmental Information
525 Wm. Penn Place
Pittsburgh, Pennsylvania 15230

# APPENDIX 3

## 101 ADDITIONAL COMPANIES WITH

## ENVIRONMENTAL ANSWERS

101 Additional Companies With Environmental Answers*

A = air pollution expertise
W = water pollution expertise
S = solid waste expertise
N = noise abatement expertise

Air Conveying Corp. (A)
South Holland, Ill.

Airco Industrial Gases, Inc. (W)
Murray Hill, N. J.

Air Maize Div. (A)
North American Rockwell Corp.
Cleveland

Air Preheater Co., Inc. (W)
Wellsville, N. Y.

American Fir Filter Co. (A)
Louisville

Aqua-Chem. Inc. (W)
Milwaukee, Wis.

Atlas Chemical Industries Inc. (W)
Wilmington, Del.

Badger Meter Mfg. Co. (A,W)
Saginaw, Mich.

Bauer Bros. Co. (S,W)
Springfield, Ohio

Betz Laboratories Inc. (S)
Trevose, Pa.

Biodize Systems Inc. (W)
Great Neck, N. Y.

Black Clawson Co. (W,S)
Middletown, Ohio

Buell Engrg. Co., Inc. (A,S)
Lebanon, Pa.

Buffalo Forge Co. (A,W,S)
Buffalo, N. Y.

Bufflovak Div. (A,W,S)
Blaw-Knox Food & Chemical Eqpt. Inc.
Buffalo, New York

Calgon Corporation (A,W,S)
Pittsburgh

Cambridge Wire Cloth Co. (A)
Cambridge, Md.

The Carborundum Co. (A,W,S)
Niagara Falls, N. Y.

Combustion Engineering Inc. (S)
Chicago

Carter-Day Co. (A,W,S)
Minneapolis

Catalytic Inc. (A,W)
Philadelphia, Pa.

Celicote Co. (A)
Berea, Ohio

Clow Corp. (W)
Chicago

Crane Co. (A,W,S)
Environmental Systems Div.
King of Prussia, Pa.

* Prepared by the editors of Industrial Ecology (now temporarily out of print)

Culligan Inc. (W)
Northbrook, Ill.

DeLaval Separator Co. (A,W)
Poughkeepsie, N. Y.

Dempster Bros. Inc. (S)
Knoxville, Tenn.

Derrick Mfg. Corp. (A,W,S)
Buffalo

DeVilbiss Co. (A)
Toledo, Ohio

Dicalite Div. Grefco, Inc. (W)
Los Angeles

Door-Oliver Inc. (W)
Stamford, Conn.

Dow Chemical Co. (S)
Midland, Mich.

Dravo Corp. (A,W)
Pittsburgh

Dubois Chemicals Inc. (S)
Cincinnati

E. I. DuPont de Nemours & Co. (A,S)
Wilmington, Del.

Foxboro Co. (W)
Foxboro, Mass.

Fuller Co. (A,W)
Catasauqua, Pa.

Ecologic Resources (A,W,S)
New York

Ecology Leasing Corp. (A,W,S)
Lake Success, N. Y.

Elmco Corp. (W)
Salt Lake City, Utah

Elgin Softener, Inc. (S)
Elgin, Ill.

Elliot Co. Div. of Carrier Corp. (W)
Jeanette, Pa.

Englehard Minerals & Chemicals (A)
Newark, N. J.

Enviro-Chem Systems, Inc. (W)
St. Louis

Envirotech Corp. (A,W,S)
Palo Alto, Calif.

Environmental Services, Inc. (W)
York, Pa.

Ethyl Corp. (W)
Flocor Div.
Baton Rouge, La.

General Electric Co. (A,N)
New York

W. R. Grace & Co. (S)
Chicago

Graver Water Conditioning Co. (W)
Union, N. J.

The Hasselberg Co. (A)
Buffalo

Haveg Industries, Inc. (W)
Wilmington, Del.

Heil-Process Equipment Corp. (A)
Cleveland

Hercules, Inc. (W,S)
Wilmington, Del.

Ingersoll-Rand (A,W,N)
New York

Ionics, Inc. (W,S)
Bridgeville, Pa.

IPCI International Pollution Control, Inc. (A)
Houston

Johns-Manville (A,W)
New York

Keene Corp. Water Pollution Control Div. (A,W)
Aurora, Ill.

Koppers Co., Inc. (A,S)
Pittsburgh

Ladish Co. (W)
Kenosha, Wisc.

Leeds & Northrup (W)
North Wales, Pa.

Link Belt, FMC Corp. (W)
Chicago

Little, Inc. (S)
Cambridge, Mass

Mapco, Inc. (S)
Tulsa, Okla.

The Marley Co. (A)
Kansas City, Mo.

Marotta Scientific Controls Inc. (A,W,S)
Boonton, N. J.

Millipore Corp. (A,S)
Bedford, Mass.

Mixing Equipment Co. (A,W)
Rochester, New York

Monsanto Co. (A,W,S)
St. Louis

Nalco Chemical Co. (W,S)
Chicago

Oxy-Catalyst, Inc. (S)
West Chester, Pa.

Penwalt Corp. (W)
Warminster, Pa.

Permutit Co. (W)
Paramus, N. J.

Pfaudler Co. (W)
Rochester, N. Y.

Pollution Control Industries Inc. (W,S)
Stamford, Conn.

Potter & Rayfield (W)
Atlanta, Ga.

Precipitair Pollution Control Inc. (A)
Bound Brook, N. J.

Procon Inc. (W,S)
Des Plaines, Ill.

Pulverizing Machinery (A,W,S)
Div. of The Slick Corp.
Summit, N. J.

Reeves Brothers, Inc. (W)
New York

Research/Cottrell, Inc. (A,S)
Bound Brook, N. J.

Rex Chainbelt, Inc. (W,S)
Milwaukee, Wisc.

Rheem Mfg. Co. (A,W)
New York, N. Y.

Ross Engineering Div. (A)
Midland-Ross Corp.
New Brunswick, N. J.

Rotodyne Mfg. Corp. (A)
Brooklyn, N. Y.

The Rust Engineering Co. (A,S)
Pittsburgh, Pa.

Solid Waste Management (S)
King of Prussia, Pa.

Technicon Corp. (W,S)
Tarrytown, N. Y.

Trane Co., The (A)
La Crosse, Wisc.

UOP Air Correction (A)
Darien, Conn.

Vibra Screw, Inc. (S)
Totowa, N. J.

Western Filter Co. (W)
Denver

Western Precipitation Div.
Joy Mfg. Co. (A,W,S)

Westinghouse Electric Corp. (A,W)
Pittsburgh

Wheelabrator Corp. (A,S)
Mishawaks, Ind.

Witco Chemical Corp. (S)
New York

Worthington Corp. (W)
Harrison, N. J.

Zurn Industries, Inc. (A,W,S,N)
Erie, Pa.

# APPENDIX IV

## INDUSTRIAL ARTS

## ENVIRONMENTAL EDUCATION

### A SELECTED READING LIST

# I N D U S T R I A L  A R T S

# E N V I R O N M E N T A L  E D U C A T I O N

A selected Reading List

Compiled by:
Mrs. Grace Manwaring
Penfield Library
June 1971
for
Professor Arthur Figurski

INDUSTRIAL ARTS ENVIRONMENTAL EDUCATION

A selected Reading List

BOOKS


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